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Vol. 13, No. 4
February 29, 1988

# Energy Research Abstracts

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# ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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*ERA* is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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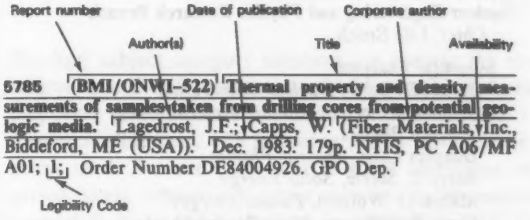
## ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

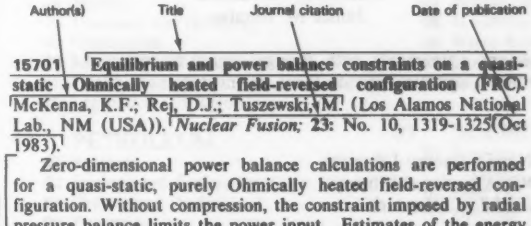
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.




**5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Abstract

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.




**15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

## INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

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Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

**5785 (BMI/ONWI–522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

**Fiber Materials, Inc., Biddeford, ME (USA)**

### • Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

**Capps, W.,** *See* Lagedrost, J. F.
**Lagedrost, J.F.,** Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**McKenna, K.F.,** Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
**Rej, D.J.,** *See* McKenna, K.F.
**Tuszewski, M.,** *See* McKenna, K.F.

### • Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

**SALT DEPOSITS**
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
**REVERSED-FIELD PINCH**
**Energy Balance**
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9: 15701 (J;AT)

### • Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

| | | |
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| **AC06-76RL01830** | **Fiber Materials, Inc., Biddeford, ME (USA)** | |
| | 9:5785 | BMI/ONWI–522 |

### • Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

| | | |
|---|---|---|
| **BMI/ONWI–522** | 9:5785 | NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70 |

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CEA Centre d'Etudes de Saclay
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Fachinformationszentrum
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IEA Biomass Conversion Service
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IEA Coal Research
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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

# SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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# ENERGY RESEARCH ABSTRACTS

## 01 COAL AND COAL PRODUCTS

### 0103 Preparation

7124 **(DOE/PC/90957—T4) Fluidization mechanisms in slurry flows: Quarterly report, November 1987.** Campbell, C.S. (University of Southern California, Los Angeles (USA)). 1987. Contract FG22-86PC90957. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002328/JAW.

There are two mechanisms by which large settling solid particles may be kept in a fluidized state in a horizontal slurry flow. These are (1) by particle-particle interactions, as in a dry granular flow, or (2) by particle-fluid interactions. This paper describes a technique for determining to what extent each mechanism is active in any given flow. At present, the project is awaiting the completion of a slurry pipe loop in which to perform the experiments. The proposed method involves the use of special pressure transducers that measure the pressure exerted only by the particle impacts. The probe design has been tested by measuring the particle pressure in a fluidized bed. The preliminary results of these experiments are presented. 9 refs., 6 figs.

### 0104 Processing

7125 **(DOE/MC/22049—2344) Fundamental mechanisms of coal gasification: Technical progress report.** Howard, J.B.; Griffin, T.P.; Ko, G.H.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). May 1987. Contract AC21-85MC22049. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87010422/JAW.

The central importance of devolatilization (pyrolysis) in any coal utilization process has been established. Volatile matter evolution is governed by a complex scheme of coupled kinetic and transport phenomena which are not fully understood. A more fundamental description of these chemical and physical mechanisms, particularly with respect to secondary reactions internal to the pyrolyzing coal particle, would provide a valuable tool for process design. Existing experimental data strongly support a consecutive reaction network with intraparticle secondary reactions in competition with mass transport. Several models exist to describe this network for the case of non-softening coals. Models have also been developed to treat extraparticle secondary reactions and the details of bubble dynamics during softening coal pyrolysis. The present goal is to generate a simplified mass transfer description and apply it in a transient model of devolatilization of softening coals that would be suitable for practical engineering applications. This would then be combined with descriptions of other transport phenomena in a global model of coal pyrolysis. The screen heater reactor has provided important experimental data regarding the global kinetics and product distributions from rapid devolatilization. This apparatus has been adapted to study the influence of several process conditions: temperature history (particularly initial heating rate), particle size, and pressure. The specific objectives of the proposed study are summarized below. 29 refs., 5 figs.

7126 **(DOE/MC/23290—2380) Fundamental research on mild gasification char fuel development: Quarterly report for the period March-May 1987.** Chu, C.I.C.; Derting, T.M. (United Coal Co., Bristol, VA (USA)). Jun 1987. Contract AC21-87MC23290. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87006503/JAW.

Great Lakes Research Corporation (GLRC) has presented a conceptual design for the bench-scale, fluidized-bed char chlorination unit. The estimated costs for the unit are substantially more than the amount originally allocated for constructing the unit. Ways to reduce the cost of the bench-scale unit are being investigated at this time. An existing rotating "graphitizer" at GLRC has been modified for the preliminary char chlorination tests. The results of the first test (2500°F, 2 cfh chlorine gas for 1 hour) showed that the ash content of the char was reduced to 6.9% from 12.8%, and the sulfur content was reduced to 0.50% from 1.10%. Additional tests with longer durations and higher reaction temperatures are scheduled.

7127 **(EPRI-AP—5343-SR) Proceedings: Sixth annual EPRI contractors' conference on coal gasification.** Holt, N. (Electric Power Research Inst., Palo Alto, CA (USA)). Oct 1987. 461p. (CONF-8610351—). Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW.

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

The Sixth Annual EPRI Contractors' Conference on Coal Gasification was held in Palo Alto on October 15 and 16, 1986. The 200 people in attendance (representing utilities, EPRI contractors, government laboratories and organizations, industry, and academia) reviewed the results of projects and other related topics. Nineteen papers were presented in five general areas: Utility Integrated Coal Gasification Combined Cycle (IGCC Studies), Pilot and Demonstration Plant Reports, Coal Gasification Developments in the Federal Republic of Germany, IGCC Support Studies, and IGCC Environmental Studies. All papers have been processed for inclusion in the Energy Data Base.

7128 **(PB—88-104658/XAB) Coal test program in a pressurized, fluidized-bed ash-agglomerating process development unit. Volume 1. Test data and chronology summary. Final report, November 15, 1984-August 31, 1987.** Sandstrom, W.A.; Goyal, A. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1987. 386p. NTIS, PC A17/MF A01.

See also First quarterly report, PB—86-163755.

The objective of the project is to extend the ash-agglomerating fluidized-bed gasification data base of important American coals to pressures of 500 psig. A series of gasification tests in IGT's 8-inch process development unit (PDU) with lignite and subbituminous coal produced steady-state data at 100, 200, and 300 psig. After GRI reviewed an analysis of the data, the PDU system was upgraded to 500 psig operating capability. A matrix of gasification tests were then completed with lignite and subbituminous coal of 200, 300, and 450 psig. Eastern bituminous-coal-gasification results from the PDU were limited to pressures of 150 psig due to defluidization caused by coal caking. These bituminous-coal-gasification data clearly reveal that a proportionally small addition of a coal char or limestone, for desulfurization, can control coal caking to obtain data at higher pressures in the PDU. An extensive process data analysis will be conducted from the matrix of gasification data obtained with the western coals and presented in a forthcoming topical report.

7129 **Residence time distribution studies in a multiphase reactor under high temperature and pressure conditions.** Nalitham, R.V.; Davies, O.L. (Catalytic, Inc., Advanced Coal Liquefaction R and D Facility, Wilsonville, AL 35186). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1059-1065(Jun 1987).

The residence time distribution of the slurry phase in a coal liquefaction reactor is determined experimentally under high temperature and pressure conditions using native radioactive tracers. The experimental data are fitted to several exit age distribution models, and a model is selected based on the best fit. The effect of

process conditions such as recycle gas rate, coal feed rate, reactor temperature, and solvent-to-coal ratio on the degree of backmixing and mean residence time is studied. Gas holdup is estimated from the experimental mean residence time, the nominal residence time, and the total reactor holdup. The effect of gas superficial velocity on gas holdup is studied.

7130 **A lumped kinetic model for hydroprocessing coal extract.** Chen, J.M.; Schindler, H.D. (Engelhard Corp., Menlo Park, NJ). *Industrial and Engineering Chemistry Research;* 26: No. 5, 921-927(May 1987).

A lumped kinetic model for hydrotreating 850+ °F coal extract is proposed in this study. This model distinguishes hydrogenation and cracking reactions that occur in the catalytic hydrotreating of coal extract. The reaction rates of aged Shell 324M Ni/Mo catalyst used to hydrotreat Illinois No. 6 coal extract were determined. Using these results, the effects of temperature and space rate on the 850+ °F conversion, as well as donor hydrogen content, were investigated. In addition, the effects of feed properties and catalyst aging on the hydrotreating performance were illustrated.

## 0106 Properties

*REFER ALSO TO CITATION(S) 7156, 7157, 7186, 7187, 7213*

7131 (EPRI-CS—5362-Vol.1, pp 18.1-18.16) **Standardized ash sampling and testing procedures.** Dalton, J.W. (American Electric Power Service Corp., Columbus, OH). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The first requirement of a successful ash marketing program is to offer ash products of assured quality and consistency, which is documented by accurate representative test data. This paper presents American Electric Power's system-wide ash sampling and testing program and the basic reasons for its establishment. The program is based on sales activities and is designed to ensure uniform test data on all of the ash products produced by twenty coal burning power plants. For ash products that are currently being marketed, the sampling and testing frequency depends on the needs of each particular operation. All products not currently being marketed are sampled and tested only often enough to maintain up-to-date base line data. The procedure provides Master Sampling and Testing Schedules and step by step instructions to be followed by personnel at each stage of the sampling and testing process. In whole or in part, these procedures should be applicable to the sampling and testing needs of the electric utilities that are engaged in ash marketing. 2 figures, 5 tables.

7132 **(PB—88-101803/XAB) Electron-transfer and radical-cation reactions of model coal compounds. Annual report, April 1, 1986-March 31, 1987.** Camaioni, D.M. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. 81p. NTIS, PC A05/MF A01.

See also report dated Oct 1986, PB—87-148763.

This report describes the annual progress of a project directed towards determining the factors that govern the breaking of carbon-carbon bonds in coal-related aryl-alkyl molecules by radical cation pathways. Reactions of coal-related radical cations were inferred from product studies of Cu(II)-peroxydisulfate oxidations of alkyl-substituted polycyclic arenes. Kinetics of electron transfer and radical-cation reactions of 1- and 2-methylnaphthalene and 9-methylphenanthrene were determined from pyridine base-promoted tris(phenanthroline)iron(III) oxidations. Methods for estimating bond-dissociation energies of radical cations were investigated; estimates for ethane, ethylene glycol, and ethylene diamine using thermochemical data are compared with ab initio molecular-orbital calculations.

7133 **(PB—88-101829/XAB) Towards a methodology for breaking carbon-carbon bonds in coal macromolecules. Topical report, July 1986-July 1987.** Arnett, E.M. (Duke Univ., Durham, NC (USA). Dept. of Chemistry). Jul 1987. 44p. NTIS, PC A03/MF A01.

See also report dated July 1986, PB—86-243748.

Heats of heterolysis were measured for 134 C-C, C-O, C-N and C-S bonds from the reaction of resonance-stabilized ions in 95% Sulfolane/5% 3-methylsulfolane solution at 25 C. A series of equations, with the general form deltaH Het = A + B $pKR^+$ + C pKa where A, B and C are constants, correlate the measured heats of heterolysis with the stability constants for the carbocations ($pKR^+$) and the anions (pKa) that are formed upon bond cleavage. Other equations were developed that replace $pKR^+$ with various other measures of carbocation stability. These equations have improved predictive powers compared to the correlation equations that utilize the $pKR^+$ variable.

7134 **(PB—88-102850/XAB) Interpretation and presentation of thermogravimetric data obtained with the equipment developed at the National Institute for Coal Research.** Saayman, C.H. (National Inst. for Coal Research, Pretoria (South Africa)). 1985. 57p. (COAL—8508). NTIS, PC E06/MF E06.

North American Continent sales only.

This report describes the thermogravimetric (TG) dispersion technique for analyzing coal samples, which was developed at NICR but based on the orthodox system as initiated by Wagoner, and outlines the way in which the data are derived, processed, and presented. It was established that the functional mechanism which is involved in the TG dispersion technique is more a process of decomposition than one of natural burning. A significant attribute of the technique appears to be its ability to provide quasi-analytical indexes that are in good agreement with the standard proximate-analysis values for the same sample. The entire process of observation and reduction of the data can be handled with a standard computer and other equipment.

7135 **(PB—88-109871/XAB) Self-heating properties of coal.** Braun, E. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). Aug 1987. 109p. (NBSIR—87/3554). NTIS, PC A06/MF A01.

Three methodologies for predicting the likely occurrence of self-heating in underground coal-mining environments were analyzed. No method was found to be completely satisfactory for general coal-mine applications. One evaluation system was found to provide excellent guidelines for preplanning procedures prior to initiating full-scale coal-mine operations, but it relied on past mining experience. Another evaluation system used standard coal-characterization parameters, while the third system used a thermal-test method as predictor of self-heating potential. The self-heating properties of eight samples of western bituminous coal were determined using the Adiabatic Furnace and the Crossing Point Method. A brief review of pertinent literature is presented to provide an understanding of those factors affecting oxidative heating of coal.

7136 **Separation and identification of carbazole, benz(e)indole and benz(g)indole in coal-derived materials.** Later, D.; Lucke, R.B.; Chess, E.K.; Franz, J.A. (Pacific Northwest Laboratory, Richland, WA (USA)). *Fuel;* 66: No. 10, 1347-1352(Oct 1987).

Nitrogen-containing polycyclic aromatic compounds (N-PAC) are generally found in products of coal utilization from processes such as liquefaction, gasification, combustion and coking. Carbazole, a three-ring pyrrole compound, is typically one of the major N-PAC components. In studying the chemical composition of the pyrrolic-PAH isolate of a solvent-refined coal (SRC) liquid, other isomers of carbazole (m/z 167) were detected by gas chromatography-mass spectrometry. From subsequent analyses, carbazole and two additional $C_{13}H_9N$ pyrrolic isomers have been identified: 1H-benz(g)indole and 3H-benz(e)indole. Isolation of the three $C_{13}H_9N$ isomers was achieved by an integrated separation method using adsorption, liquid and gas chromatography. Molecular structures and elemental compositions were determined by high-resolution mass spectrometry, ultraviolet spectrophotometry and nuclear magnetic resonance spectroscopy. Carbazole, 1H-benz(g)indole and 3H-benz(e)indole were identified in a SRC distillate liquid and a commercial creosote oil. 29 refs., 4 figs., 3 tabs.

7137 **Identification of polyaromatic carbonyl compounds in a neutral coal oil fraction.** Ma, C.Y.; McBay, E.H.; Ho, C.-H.; Griest, W.H. (Oak Ridge National Laboratory, TN (USA). Analytical Chemistry Division). *International Journal of Environmental Analytical Chemistry;* 30: No. 1/2, 37-49(1987).

An aromatic carbonyl compound-enriched fraction constituting 0.14 wt% of a crude coal liquid was isolated by acid-base extraction, followed by Sephadex LH-20, silicic acid and normal phase HPLC separations. Analysis of this fraction by GC/MS showed six major peaks which were identified as benz(d)anthracenone, $C_1$-benz(de)anthracenone, $C_2$-benz(de)anthracenone, benzo(cd)pyrenone, and $C_1$-benzo(cd)pyrenone. High resolution mass spectrometric and infrared spectroscopic analyses of this fraction exclude the presence of isobaric compounds, such as dibenzocinnoline. Benz(de)anthracenone, the most prevalent carbonyl species was confirmed by comparison of GC retention time and high resolution mass spectrum with that of an authentic standard. It was estimated to be present at 150 ppm in the crude coal oil sample. The other five components were tentatively identified by high resolution mass spectrometry and determined at 7-38 ppm each. 19 refs., 4 figs., 3 tabs.

## 0108 Waste Management

*REFER ALSO TO CITATION(S) 7128, 7131, 7438, 7440, 7608*

7138 (EPRI-CS—5362-Vol.1, pp 1.1-1.24) **EPRI coal ash utilization research.** Golden, D.M. Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

This paper describes a ten-year Electric Power Research Institute (EPRI) program directed toward increasing ash utilization. EPRI is undertaking this program to promote the bulk sale of coal ash in high-volume applications that do not require a specific quality or class of ash; in medium technology applications in cement and concrete; and in high-technology uses for valuable products requiring stringent quality control. High-volume applications include the use of ash in highways and railroads, backfills, and pavement base courses; medium-technology applications include cement and concrete; and high-technology applications include the extraction of mineral matter or the metals from ash and the beneficiation of the spent ash by-products for such uses as plastic fillers. 8 references, 5 figures, 11 tables.

7139 (EPRI-CS—5362-Vol.1, pp 2.1-2.15) **Georgia stabilized ash highway demonstration project.** Larrimore, C.L.; Robnett, Q.L. (Southern Co. Services, Birmingham, AL). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Many coal-burning utilities in the US are beginning to view ash as a resource material rather than only as a liability. This emphasis is due largely to space limitations at many plants, rising storage and disposal costs, plus the opportunity for income from ash marketing. This paper discusses the potential high-volume use of bottom ash (and fly ash) in highway construction. Extensive laboratory and field evaluations have involved a number of plants in the Southern electric system (Alabama Power, Georgia Power, Gulf Power, Mississippi Power, Southern Electric Generating Co., Southern Company Services, and Southern Electric International). This paper describes key laboratory results plus findings from the construction and monitoring of a full-scale pavement project in Georgia. This field study was done in conjunction with the Georgia DOT and involved the construction of a demonstration project in which several types of ash were used as major components in highway pavement construction. 2 references, 3 figures, 4 tables.

7140 (EPRI-CS—5362-Vol.1, pp 3.1-3.8) **Phoenix from the ashes.** Engelhart, J.R.; Edwards, D.L. Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

FBA-Hypermag is a high permeability aggregate made from furnace bottom ash and used in the construction of highways and large-scale commercial development projects in Great Britain. This paper describes several construction projects in which FBA-Hypermag has been used. It drains freely, has heavy-duty loading capacity, is free of contaminants, and age-hardens on compaction.

7141 (EPRI-CS—5362-Vol.1, pp 4.1-4.4) **Newark International Airport: the lime-cement-fly ash (LCF) pavement story.** Fasullo, E.J. (Port Authority of New York & New Jersey, NY). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

From its inception, Newark International Airport has been a pioneer in air transportation. The innovative use of LCF (lime-cement-fly ash) in airport pavement construction was in keeping with that tradition. The airport had to keep pace with the tremendous growth that was forecast so additional facilities were needed. A Master Plan was developed to construct new facilities in the remaining marsh land area. In 1965, more the 15,000,000 cubic yards of hydraulic sand were pumped into the marsh land. A substitute was necessary for the fines that had been washed out of the sand in the pumping. Without fines the sand grains cannot develop interlocking action necessary for stability under load. Laboratory researchers developed a mixture of hydrated lime, Portland cement, fly ash and the in-place sand to be used as a base for the Newark Airport pavement. Test pavements embodying the old and the new design concepts and materials were built and subjected to heavy wheel-load field testing. Data collection and analysis confirmed the LCF pavement concept. In the Spring of 1968, construction of the new LCF pavement at Newark Airport began. Because of the slow initial setting, the LCF material may be reworked and regraded up to 48 hours after the initial mixing. The compressive strength of the mix increases significantly with age; and tests on cores taken years after the existing pavement was laid indicate that the compressive strength requirements of the original design have been exceeded. 2 references.

7142 (EPRI-CS—5362-Vol.1, pp 5.1) **Lime, cement, and fly ash stabilized aggregate base airfield pavement: Houston Intercontinental Airport.** Jefts, A.R. (Turner Collie & Braden, Inc., Houston, TX). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

In the summer of 1987, the City of Houston completed over six miles of runways and taxiways at the Houston Intercontinental Airport using a 28-inch thick multilayered stabilized base of aggregate stabilized with a combination of lime, cement and fly ash called LCF. This material, which comprised the primary load carrying component of the pavement section, was topped with a 3-inch thick asphaltic concrete wearing surface. After a thorough investigation of the properties of local natural materials, it was concluded the proper materials were available in sufficient quantities in the Houston area to provide an economical LCF airfield pavement section. The laboratory and subsequent field testing indicated the LCF would attain strengths of 1200 to 1500 psi in six months and as high as 2500 to 3000 psi in 10 to 20 years. The primary strength gain comes from the interaction of the lime and fly ash and by highly compacting the mixture. Two pugmills were used to mix the LCF components, each pugmill producing about 500 to 700 tons per hour. Conventional earthwork equipment was used to place and compact the material. A total of 720,000 tons of material comprised 619,200 tons aggregate 68,400 tons fly ash; 28,800 tons lime and 3600 tons cement used on this project. Cost savings to the City of

Houston were estimated at over $8 million by using this type of pavement rather than a conventional concrete pavement.

7143 (EPRI-CS—5362-Vol.1, pp 6.1-6.13) **Production and utilization of scrubber sludge.** Snow, P.G.; Gehrmann, B.; Carrasquillo, R.L. (Ash Management Systems, Inc., Houston, TX). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

This paper briefly describes the flue gas desulfurization system which is in place and operating at a Texas based electric power generating company. Applications for utilization of the resultant scrubber sludge are described in more detail. The research, development, and marketing of this by-product is discussed. It has been used for soil stabilization, as a base material for parking lots and secondary roads, and in blends with bottom ash as a wearing surface. 3 tables.

7144 (EPRI-CS—5362-Vol.1, pp 7.1-7.6) **Eleven million tons of fly ash yearly in FGD sludge fixation.** Smith, C.L. (Conversion Systems, Inc., Horsham, PA). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

This paper provides a status report on the chemical process consuming the greatest annual volume of fly ash. This is an unsung usage in that American Coal Ash Association statistics do not identify, as such, the approximately eleven million tons of fly ash consumed yearly in the Poz-O-Tec process for stabilization of flue gas desulfurization sludge. 4 tables.

7145 (EPRI-CS—5362-Vol.1, pp 8.1-8.19) **Utilization of advanced SO control by-products: laboratory test results.** Manz, O.E.; Collings, B.A.; Perri, J.S.; Golden, D.M. (Univ. of North Dakota, Grand Forks). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

As part of the Electric Power Research Institute's (EPRI) Advanced $SO_2$ Control Waste Management Project, by-products from four advanced $SO_2$ control systems were analyzed for physical and chemical properties and tested in the laboratory for potential suitability in various by-product utilization applications. The by-products tested included fly ashes from atmospheric fluidized bed combustion (AFBC), calcium spray dryer, limestone furnace injection, and dry sodium injection systems for $SO_2$ removal. Utilization applications investigated in the laboratory included: road base, soil and sludge stabilization; asphalt mineral filler; mineral wool, brick, ceramic, and aggregate production; and partial cement replacement in grout and concrete. Standard ASTM test procedures were used where applicable to evaluate the potential suitability of the ash for use in the particular application. Laboratory test results reported here will provide input for selection and evaluation of potential advanced $SO_2$ control ash utilization markets in the next phase of the utilization study. 5 references, 11 tables.

7146 (EPRI-CS—5362-Vol.1, pp 9.1-9.13) **Fly ash used in solidification of highly concentrated sulfate chemical waste.** Hsu, C.C.; Chiou, S.L.; Quo, L.W.; Kuo, S.T. Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

According to the criteria of radiowaste disposal, liquid chemical waste in BWR nuclear power plant is disposed by the processes of concentration, neutralization, and solidification. This project studies the feasibility of fly ash as an alternative in the solidification treatment. A non-radioactive simulate sample solution which contains $Na_2SO_4$, $MgCl_2$, NaCl, etc. in total amount of 200 g/l, especially $Na_2SO_4$ up to 112 g/l, was prepared for the experiments. Portland cement Type I, Type V, and Portland cement with fly ash in different percentage replacements were mixed well with the sample respectively under the surfactant agent in existing and warming conditions. Compressive strength of the casted specimens were tested after different curing age. Results of laboratory test showed that fly ash used in solidification of highly concentrated sulfate liquid waste has improved quality significantly and saved cost largely. Therefore, a further demonstration test will be conducted at the power plant site. 4 references, 12 figures, 1 table.

7147 (EPRI-CS—5362-Vol.1, pp 9.4.1) **Windsor Gypsum Company and Texas Utilities work together on wallboard.** Boone, J.P.; Woods, E.; Dorsett, J.R. (Windsor Gypsum Co., Houston, TX). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Demonstrating how utilities and private industry can work hand-in-hand, Texas Utilities and Windsor Gypsum Company of Tatum, Texas are producing wallboard and utilizing the TU Tatum plant's scrubber synthetic gypsum. Mr. J. P. Boone, president of Windsor Gypsum Company, decided it was economically feasible to locate a new $32,000,000 plant near Tatum and the TU power plant, and completed installation in time for an early December, 1986, opening. Details are provided of processing and hauling of gypsum by the TU transportation network, the specialized open-air plant design for off-loading and storage of gypsum, and specialized furnace and mechanized assembly line for producing wallboard economically and efficiently.

7148 (EPRI-CS—5362-Vol.1, pp 10.1-10.9) **Overview of the use of fly ash in slurried placement applications.** Brendel, G.F.; Balsamo, N.J.; Glogowski, P.E. (GAI Consultants, Inc., Monroeville, PA). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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Fly ash slurry, a mixture of fly ash, water, and a small amount of cement, sets to achieve strengths much greater than that of the surrounding soil. Where economically advantageous, aggregate may replace a portion of the fly ash. Low cost and ease of placement make this material suitable for a variety of applications. The major advantage of fly ash slurry over compacted soil is that it can be placed quickly and with minimal labor. As a slurry, the material flows into place, filling small voids and uneven surfaces. Slurry can be mixed at a low slump to remain in a restricted area, or at a higher water content to self-level, eliminating manual spreading. This paper discusses slurry properties; its use as a trench backfill, retaining wall backfill, and fill for abandoned underground structures; mix design; and materials handling.

7149 (EPRI-CS—5362-Vol.1, pp 11.1-11.7) **Flowable mortar in Iowa.** Buss, W.E. (Iowa Dept. of Transportation, Ames). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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The Office of Materials, under the direction of Ralph Britson, developed a backfill material consisting of 212 pounds of Type 1 portland cement, 505 pounds of Type F fly ash, 2232 pounds of sand, and 438 pounds of water. Using this material, granular backfill, and soil backfill, a comparison was set up within a project in which nine culverts were being replaced. This paper describes the use of flowable mortar as a culvert backfill and a bridge backfill. An appendix summarizes the specifications for flowable mortar. 15 figures, 2 tables.

7150 (EPRI-CS—5362-Vol.1, pp 12.1-12.13) **Controlled density low strength material backfill in Illinois.** Weber, L. (American Fly Ash Co., Des Plaines, IL). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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Flowable mortars have been utilized for many years as a backfill material. Many applications have been cited. Controlled low strength materials are unlike flowable mortars in that limited ultimate strength development is the major objective. Controlled Density Low Strength Material (C.D.L.S.M.) can utilize locally available aggregates, which can enhance the economics of the mixture but adds quality variables to the potential mix designs and strength performance. These variables alter mix characteristics which translate into field performance questions or concerns. During the past year, there has been a growing interest with the engineers of the City of Chicago as well as the Illinois Department of Transportation of utilize controlled density low strength materials as a trench backfill. This paper documents a laboratory investigation of specific engineering characteristics of C.D.L.S.M. utilizing local aggregates and variable percentages of fly ash. The effects of various C.D.L.S.M.'s on utility applications as well as short and long term strength development were studied. Field test sections were installed and are being evaluated. The paper concludes with proposed specification guidelines which provides for the utilization of large amounts of fly ash in C.D.L.S.M. applications. The specific application of this specification is as backfill in utility trench cuts. 5 tables.

7151 (EPRI-CS—5362-Vol.1, pp 13.1) **Applications for coal ash in construction.** Pintcke, T.P. (Black & Veatch, Kansas City, MO). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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This paper discusses two cases of less common yet highly successful applications for coal ash in construction. The applications discussed utilize cement treated coal ash as an additive in conventional unreinforced concrete pavement and in lean concrete backfill in utility construction. The applications show that coal ash can be safely utilized and reduce costs during construction. Case 1 is a roller compacted concrete paved coal stockout, storage, and reclaim area. Both bottom ash and fly were used as partial substitutes for crushed aggregate and cement, respectively. As expected, the mix design resulted in a significant cost savings to the owner. Not expected, but readily accepted, was the surprising high strength and durability of the unusual roller compacted concrete mix design. Case 2 is a high-pressure insulated steam line bedded in a cement treated fly ash slurry also known as flowable fill. The steam line is buried within the city streets of a large metropolitan area. A backfill technique providing ease of placement, support, and moderate protection was sought. Existing steam lines in the area were embedded in lean concrete. The flowable fill satisfied the engineering requirements and resulted in an estimated $1.5 million savings to the owner. The flowable fill provides less protection than the lean concrete originally used, but it is more easily removed to make line taps for new customers.

7152 (EPRI-CS—5362-Vol.1, pp 14.1-14.31) **Fly ash concrete - technology revisited: experience with several sacred cows.** Head, W.J.; Sajadi, J. (West Virginia Univ., Morgantown). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Substantial quantities of fly ash are employed as pozzalans in concrete technology. While agency practices differ, upper limits of the amount of cement replaced by fly ash in typical fly ash concretes ranges from about 15 to 25%; i.e., technology seems to have stabilized at about those replacement levels. Recently however, at West Virginia University and elsewhere, attempts have been made to develop useful concrete mixtures in which very large amounts of cement have been replaced by fly ash. Attempts were also made to develop fly ash concretes in which a high carbon content ash appeared. In effect, the established fly ash concrete technology was revisited with several questions in mind. What is sacred about 20 weight or volume percent replacement of cement by fly ash in concrete mixtures? Why not 40 or 60%? What is sacred about how carbon content fly ash as a pozzolan? Can high carbon ash be used in the production of useful concrete? What about freeze/thaw durability? Is fly ash concrete inferior to conventional concrete? The purpose of this paper, then, is to provide a forum for addressing these questions. It should be noted that useful concrete as used herein is concrete which is adequately workable, strong, and durable with respect to freezing and thawing. 12 figures, 6 tables.

7153 (EPRI-CS—5362-Vol.1, pp 15.1-15.22) **Fly ash application to steel fiber reinforced concrete.** Bayasi, Z.; Soroushian, P. (Michigan State Univ., East Lansing). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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The effects of substituting cement with fly ash in steel fiber reinforced concrete on the fresh mix and the hardened material properties were studied experimentally. For fibrous mixes with 0%, 20%, 30%, and 40% of cement substituted with fly ash, slump and inverted slump cone procedures, as well as a subjective method were used to assess the fresh mix workability. Complete compressive and flexural load-deformation relationships at the age of 28 days were also generated for different mixes. The development of compressive strength with time, up to an age of 28 days, was also measured. Further, the optimum range of fly ash-cementitious ratio for achieving desirable fresh mix and hardened material characteristics in the fibrous mix of this study was determined. 18 references, 10 figures, 1 tables.

7154 (EPRI-CS—5362-Vol.1, pp 16.1-16.20) **Setting and hardening of high fly ash content concrete.** Naik, T.R.; Ramme, B.W. (Univ. of Wisconsin, Milwaukee). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

This paper present research performed for determining setting and hardening characteristics and other specialized hardened concrete properties. The concrete contained fly ash in quantities of up to 55% of the total cemetitious material. The results reported herein were part of a larger project, the basic objectives of which were to identify and recommend mix proportioning for high fly has content structural grade concrete utilizing ASTM C618 Class C fly ash. The fly ash was produced at Wisconsin Electric Power Company's Pleasant Prairie Power Plant located in Pleasant Prairie, Wisconsin. Concrete for mix proportioning was produced at two ready mixed concrete plants utilizing different cement and aggregate sources. Concrete with and without air entrainment was produced in which fly ash was substituted for cement in quantities of up to 70% of total cement replacement. Compressive strength, air content, density, setting and workability characteristics were observed. The design compressive strength at 28-day age was 3000, 4000 and 5000 psi; slump varied between 3" and 5" and air content varied between 3% and 7%. A specialized series of laboratory tests were performed on mixes in which fly ash was substituted for cement in quantities of 35% to 55% of total cement replacement. Testing consisted of freeze and thaw, compressive strength, Poisson's Ratio, modulus of elasticity, drying shrinkage, and time of set tests. Time of set test data represents eighteen different types of concrete mixes. 23 references, 8 tables.

7155 (EPRI-CS—5362-Vol.1, pp 17.1-17.9) **Quality concrete with fly ash.** Larsen, T.J.; Armaghani, J.M. (Florida Dept. of Transportation, Tallahassee). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Fly ash has been used in structural concrete for strength improvement, in mass concrete for heat reduction, in grout for subsealing of slabs and pavements, as a pumping aid, and for better handling, placing, and finishing of concrete. It has been claimed to reduce creep, shrinkage and permeability. Based on research and the recommendation of a board of experts, the Florida FDOT incorporated fly ash as a vital ingredience for all concrete placed in sea and other aggressive environments. Fly ash was incorporated in all concretes used in the Sunshine Skyway bridge project where more than two hundred thousand cubic yards of concrete were placed. This paper discusses the benefits of fly ash in concrete to (1) inhibit corrosion, (2) provide sulfate resistance, and (3) reduce temperature at set and at later ages during hydration in hot weather concreting and in mass concrete construction. Initial specification requirements for fly ash used in the Skyway construction are discussed and later modifications are outlined. Fly ash is used as an admixture in concrete to improve its properties in aggressive environments. However, the addition of fly ash will also increase concrete strength. For important projects the mix design should account for both durability and strength increase of the concrete when fly ash is part of the cementitious material.

7156 (EPRI-CS—5362-Vol.1, pp 19.1-19.13) **Pozzolan programs of the cement and concrete reference laboratory.** Pielert, J.H.; Kolos, R.M. (National Bureau of Standards, Gaithersburg, MD). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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The Cement and Concrete and Reference Laboratory (CCRL) located in the Center for Building Technology of the National Bureau of Standards has as its goal the improvement in the quality of testing of construction materials. This is accomplished through the inspection of laboratories who test construction materials, distribution of proficiency samples, studies of testing problems, and participation on technical committees. Until recently, the inspection and proficiency sample program considered portland, blended and masonry cements; portland cement concrete; aggregates; and reinforcing steel. In response to requests of the joint ASTM C1/C9 Sub committee on the CCRL, two new programs related to pozzolans have been added; a pozzolan laboratory inspection program was begun in January 1987 and the distribution of a fly ash references sample is planned for September 1987. This paper provides a short overview of CCRL programs for cement, concrete, aggregates and reinforcing steel and give specifics on the pozzolan programs including scope of coverage, schedules, costs, anticipated benefits, and participation information. 10 references, 2 figures, 3 tables.

7157 (EPRI-CS—5362-Vol.1, pp 20.1-20.10) **On-line measurement and reduction of carbon in fly ash.** Trerice, D.N.; DiGioia, A.M. Jr. (Energy, U.S.S., Pittsburgh, PA). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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The presence of significant levels of carbon in fly ash (greater than 3%) present a major problem to both the electric utility and the ash marketer. To the utility, fly ash carbon results in higher operating costs because fuel that could have been used to generate revenues is lost with the fly ash. To the utility and the marketer, carbon levels higher than permitted by specification preclude the sale of the fly ash in the cement replacement market and potential sales revenues are lost. With present techniques for determining ash carbon content, extensive and time consuming representative sampling must be performed under changing generating unit operating conditions to investigate the cause of excess carbon. Because of the time required for sampling and analysis, the root cause of the excess carbon problem may change and elude the investigator. A need for continuous on-line carbon in ash measurement (CAM) was perceived and a novel method utilizing microwave energy was developed. Because some generating units will not have an economical path to lower carbon in fly ash levels to cement replacement requirements, a need for a reduction of ash carbon (RAC) process also presented itself. Development and demonstration of a microwave-based technology for both CAM and RAC are proceeding and this paper discusses the technology and potential uses for this novel method. 5 figures.

7158 (EPRI-CS—5362-Vol.1, pp 21.1) **Monitoring of ash embankment construction for Interstate Route 495 in Delaware.** Collins, R.J.; Srivastava, L.F.; Donofrio, A.J. Jr.; Golden, D.M. (VFL Technology Corp., Malvern, PA). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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Nearly 10,000 tons of stockpiled fly ash from Delmarva Power and Light Company's Edge Moor Station were used to construct the main access ramps for a new interchange to Interstate Route 495 near Wilmington, Delaware during June 1987. This project has been selected for inclusion in the Electric Power Research Institute (EPRI) program for evaluating and monitoring high volume applications for the utilization of fly ash in highway construction. Delmarva Power and Light Company (DPL) is under contract to EPRI, with VFL Technology Corporation (VFL) as subcontractor, to provide a comprehensive documentation of the placement and performance of the ash embankment over a three year time period. Included in the monitoring program are background laboratory analyses of representative fly ash samples, on-site testing of fly ash placement and compaction behavior, collection and analysis of ground water and runoff samples in the vicinity of the ash fill area, periodic core sampling and laboratory analysis of material from within the ash fill, settlement monitoring, preparation of summary reports, and the production of a 20 minute videotape record of the project.

7159 (EPRI-CS—5362-Vol.1, pp 22.1-22.16) **Road base construction utilizing coal waste materials.** Hunsucker, D.; Sharpe, G.W.; Rose, J.G.; Deen, R.C. (Univ. of Kentucky, Lexington). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The paper describes the development and implementation of a no-cement concrete mixture containing pulverized fuel ash (PVA) and atmospheric fluidized bed combustion (AFBC) by-products as the cementitious components for combination with conventional limestone aggregates used as bulk filler. The paper presents a summary of laboratory evaluations and the application of those results to the design of a base for roadway construction. The paper also describes the construction, evaluation, and performance of a pilot application of this material used as a base or a thin bituminous pavement. Test sections were constructed in 1985: a) a 50-foot section consisting of a blend of PVA-AFBC-limestone aggregate constructed to a nominal thickness of 6 inches and overlaid with a nominal 3 inches of asphaltic concrete, and b) an adjacent 100-foot section constructed of the same materials but with a small proportion of cement substituted for a portion of the crushed limestone aggregate. The optimum PVA-AFBC-limestone aggregate mixture appears to be usable as a roadbase material. To date, test sections have performed admirably with no cracking or deterioration observed. The roadbase mixture appears marginally as strong as typical concrete but has a lower elastic modulus and is less brittle than typical concrete and other rigid base materials. The PVA-AFBC-limestone concrete expands slightly, potentially reducing shrinkage cracking typically associated with other rigid base materials. Field evaluations thus far confirmed these observations.

7160 (EPRI-CS—5362-Vol.1, pp 23.1-23.13) **Cement-stabilized fly ash road shoulder base in Michigan.** Berry, W.H. Jr.; Tons, E. (Consumers Power Co., Jackson, MI). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The use of fly ash in construction applications in not new. Large quantities of fly ash are available for engineering use, and increased electric utility consumption of low sulfur coal will contribute to a supply of high carbon ash. Priority consideration for this EPRI-sponsored program was the use of fly ash in large volume, not as an additive or minor component. This lead to the idea of designing and trying plain fly ash with cement as a binding agent, mixed with water and compacted to a ten-inch thickness in a pavement shoulder base course. The proportions were 88% fly ash and 12% cement by weight of solids. The project started with a survey of literature, checking of local fly ash availability and characteristics, and a comprehensive laboratory investigation, including mix design, preparation techniques, and measurement of the pertinent properties of the compacted fly ash and cement mixtures. This was followed by planning of a test highway section, search and design of field installation equipment, establishment of construction procedures, and finally scheduling and actual construction of the base course. It was finished on June 1, 1987. The paper describes the laboratory work, field test planning, construction procedure, monitoring, and conclusions. 2 figures.

7161 (EPRI-CS—5362-Vol.1, pp 24.1-24.9) **Uses of coal ash in highway subgrades and pavements in Mississippi.** Crawley, A.B.; Sheffield, J.P. (Mississippi State Highway Dept., Jackson). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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This paper describes the use of fly ash and, to a very limited extent, power plant pond ash, for subgrade stabilization and base course mixtures by the Mississippi State Highway Department (MSHD). Single projects were build in 1983 and 1985 and two projects are now under contract. All four projects are described. They are a subgrade stabilization on SR63, a base course in Adams and in George Counties, and a pond ash base course in Stone County.

7162 (EPRI-CS—5362-Vol.1, pp 25.1-25.13) **Aggregate bases constructed with self-cementing fly ash.** Ferguson, E.G. (Terracon Consultants SE, Inc, Lenexa, KS). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The paper presents information developed to evaluate the feasibility of constructing a stabilized aggregate base utilizing Class C fly ash as the sole stabilizing agent. The laboratory study afforded an opportunity to more thoroughly evaluate the influence of a commercially available retarder on a Class C fly ash and provide some insight as to the degree of stabilization possible by these procedures. Based on the results of the laboratory study, the material was approved as an alternate by the Kansas Department of Transportation and was used for the construction of an interchange at Interstate 435 and Quivira Road in Overland Park, Kansas. In addition to delaying the rate of set it was demonstrated that the retarder used for the project actually increased the strengths of the stabilized material even when there was not delay in compaction. The retarder also has a pronounced affect on the long term strength gains with 7 day compressive strengths being on the order of 40 to 60% of the 28 day compressive strengths and significant gained beyond 28 days. Finally, the project demonstrated the feasibility of producing a stabilized base section as a road mix using conventional equipment and eliminating the need of a pugging operation. 3 figures, 4 tables.

7163 (EPRI-CS—5362-Vol.1, pp 26.1-26.11) **Improving crop yield potentials of coarse textured soils with coal ash amendments.** Erickson, A.E.; Jacobs, L.W.; Sierzega, P.E. (Michigan State Univ., East Lansing). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Soil physical laboratory studies with soil and coal fly ashes indicated that fly ash amendments to coarse textured sands and loamy sands could improve the water-holding capacity of these droughty soils. Therefore, field experiments were established in 1985 and 1986 to evaluate high rates (200-600 tons/acre) of fly ash amendments on agricultural soils. Such an amendment would make a permanent physical modification of the soil which could significantly increase potential crop yields, while providing an additional waste management alternate for the utility company. Field studies were designed to: (i) investigate the best ways of applying and incorporating fly ash into agricultural soils, (ii) evaluate the extent of improvement in water-holding capacity of soils, (iii) determine effects of ash amendments on yields and quality of crops, and (iv) assess the potential risk of losing soluble constituents to ground water. Yields and chemical composition of field corn, soil moisture contents during the growing season, and chemical composition of leachate waters are being monitored. Preliminary results of yields and soil moisture contents suggest significant increases due to fly ash amendments. Problems encountered during the first two years and progress to date are discussed. 11 references, 1 table.

7164 (EPRI-CS—5362-Vol.1, pp 27.1-27.18) **Utilization of fly ash for reclaiming abandoned mine spoils for the production of agricultural crops.** Ghazi, H.E.; Bhumbla, D.K.; Keefer, R.F.; Singh, R.N. (West Virginia Univ., Morgantown). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Greenhouse and field studies were conducted to evaluate fly ash and rock phosphate as amendments to ameliorate toxic conditions in three extremely acid mine spoils for the production of agricultural crops. The mine spoils were located near Lenox and Valley Point in Preston County, WV and near Westover in Monongalia County, WV. All sites were mined for coal before 1970 and contained considerable amounts of pyritic sulfur near the surface. Several attempts to revegetate these spoils with lime and fertilizer were unsuccessful. The sites showed wet spots under dry conditions indicative of the presence of free acid produced by pyrite oxidation. Use of 400 and 800 metric tons of fly ash per hectare on these strip mine spoils resulted in alfalfa growth which appeared as good as that grown on natural soils in WV. On the other hand, alfalfa either did not grow or showed very poor growth in the greenhouse but grew better in the field where lime, fertilizer, or rock phosphate was applied. Growth of corn plants in the greenhouse was hindered by fly ash application probably due to the high boron concentration in the fly ash which was absorbed by the plants. Concentrations of boron in alfalfa were also high from the fly ash, but the alfalfa grew well since this crop can tolerate high amounts of boron. Combining rock phosphate with fly ash reduced boron concentrations in both species. 28 references, 4 figures, 7 tables.

7165 (EPRI-CS—5362-Vol.1, pp 28.1-28.26) **Direct (soil-less) revegetation of anthracite waste using coal fly ash as a major soil amendment.** Buck, J.K. (GAI Consultants, Inc., Monroeville, PA). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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The Pennsylvania Power and Light Company (PP & L) used fly ash as a major soil amendment to prepare a ten acre anthracite waste site for direct (soil-less) revegetation. The site is located at Harwood, near Hazleton, Pennsylvania. In the laboratory, experimental mixtures of fly ash and soil were used by GAI investigators to estimate the chemical and physical suitability of various rates of ash amendment for establishment of vegetation. Based on laboratory studies, fly ash was applied to the anthracite wastes at a rate of 200 dry tons per acre, and, in combination with agricultural limestone and fertilizers, was plowed into the wastes to a depth of 10 inches. For comparison, a soil-covered control plot was established at the site. The site was seeded in September 1984. The success of

vegetation and the chemistry of the soil and ash-amended coal wastes is being monitored annually. Plant tissue analyses were begun in 1987. Water quality is also being monitored. Vegetation response has been vigorous in the fly-ash-amended coal wastes and is comparable to that in the soil-covered control plot. Excellent erosion control and partial release of the revegetation performance bond was achieved in the establishment year of the site. Plant tissue analyses recently conducted indicate normal uptake of nutrients and trace elements from fly-ash-amended coal wastes, with the exception that molybdenum and selenium uptake was high. Water quality effects have been generally positive. 9 references, 5 figures, 3 tables.

7166 (EPRI-CS—5362-Vol.1, pp 29.1) **Fly ash for sanitary sewage sludge stabilization/disposal.** Nowicki, M.L. (American Fly Ash Co., Des Plaines, IL). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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American Fly Ash Company, in cooperation with the North Shore Sanitary District of Lake County, Illinois, has developed a long-term sanitary sewage sludge stabilization/disposal project utilizing up to 200,000 tons of fly ash per year. This paper provides an overview of that project. The problems which the District had been experiencing with its previous sludge disposal methods are discussed together with the alternative approaches to resolving the District's need for a long-term sludge management/disposal practice. The process of determining the technical and economic feasibility of using fly ash to meet the District's requirements are discussed. The promotional process with the District, a public agency, is also reviewed. The status of current operations including the stabilization/disposal process, the quantities and qualities of fly ash utilized, and the plant adjustments required for variable fly ash quantities and qualities, are discussed. Also, a summary of the benefits realized by the District and the utilities involved in the project is provided.

7167 (EPRI-CS—5362-Vol.1, pp 30.1-30.8) **Stack gas desulfurization waste effects on long-term alfalfa yields and soil chemical characteristics.** Mays, D.A.; Giordano, P.M. (Tennessee Valley Authority, Muscle Shoals, AL). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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Fluidized bed combustion waste (FBCW), limestone scrubber sludge (LSS), and dolomitic limestone were sued to lime alfalfa plots planted in 1978 and harvested from 1979 through 1985. All soil amendments were satisfactory lime sources in terms of soil pH change and alfalfa yield. Rates as high as 18 tons per acre of FBCW and 144 tons per acre of LSS were applied with no harmful effects to the soil or plants. In addition to effecting soil pH changes, high rates of LSS supplied sulfur and boron to alfalfa. 5 references, 3 tables.

7168 (EPRI-CS—5362-Vol.1, pp 31.1-31.13) **Potential use of atmospheric fluidized bed combustion AFBC material as a liming agent for acid soils.** Barnhisel, R.I.; Thom, W.O. (Univ. of Kentucky, Lexington). Oct 1987. NTIS, PC A18/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000539/JAW. (CONF-8710155—Vol.1).

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The primary objective of this study was to evaluate AFBC spent bed material (SBM) as a substitute for calcium carbonate as a liming agent for acid soils. The pH of acidic soils was raised as rapidly with SBM as was found for $CaCO_3$, when the applied rates were on an equivalent $CaCO_3$ basis. Caution must be used to avoid excessive rates of SBM for at least three reasons: (1) soil pH may be raised too rapidly which could reduce plant growth; (2) adequate mixing of SBM is needed to avoid problems with soil crusting, especially when high rates are needed as the soil could become hard similar to plaster; and (3) excessive rates can raise the pH high enough to reduce seed germination. High soil pH reduced germination small seeds (alfalfa) but not larger seeds (soybeans). SBM provided a readily available source of calcium and sulfate-sulfur. It also supplied boron and zinc under some soil test conditions. Concentrations of the environmentally-sensitive heavy metals (Pb, Cd, Cu, Ni, and Cr) in harvested plants were not related to treatment variables and most elements were below the detection levels. When SBM was used as a topdressing, some elements (Al, Mn, Zn and Mo) were at or near levels considered to be excessive. 12 references, 1 figure, 4 tables.

7169 (EPRI-CS—5362-Vol.2, pp 32.1-32.21) **Performance of fly ash in roller compacted concrete at Upper Stillwater Dam.** Dolen, T.P. (Bureau of Reclamation, Denver, CO). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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Roller compacted concrete, commonly referred to as RCC, is a dam construction method which combines the strength and impermeability of concrete dams with the rapid placing rates of embankment construction. No-slump concrete is mixed with conventional drum or shaft-driven paddle mixers, transported by end-dump trucks, spread into horizontal layers varying from 1 to 3 feet by a bulldozer, and compacted to a solid mass by a smooth-drum vibratory roller. Upper Stillwater Dam is the world's largest RCC dam and, when completed in August 1987, will have a total volume of over 1.6 million $yd^3$ of concrete of which 1.4 million $yd^3$ will be RCC. Fly ash (class F pozzolan) has been used as a cementitious component for concrete in ratios ranging from 23% (by weight) for structural concrete to up to 70% for RCC. Over 225,000 tons of fly ash have been used at Upper Stillwater Dam, making it one of the largest single applications of fly ash in concrete in the world. The paper describes the use of fly ash in roller compacted concrete, reviews laboratory studies, and explains concrete mix designs and materials, and quality control testing and inspection. The performance results of the fly ash are given. 2 references, 11 figures, 6 tables.

7170 (EPRI-CS—5362-Vol.2, pp 33.1-33.20) **Roller compacted type "C" fly ash and aggregate armor liner for coal yard ditches.** Bugni, J.A.; Sedlacek, R.L.; Schnake, A.E. (Burns & McDonnell Engineering Co., Kansas City, MO). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

KCP & L's need to identify an armor-coat ditch liner material for coal pile rainwater runoff improvements at various plant sites led to an evaluation and use of a mixture of fly ash, bottom ash, and aggregate as a ditch liner. An extensive laboratory testing program was conducted to determine if fly ash-aggregate mixtures were capable of providing the required strength, freeze-thaw durability and resistance to sulfate. Twenty different mixes were evaluated using fly ash from the Hawthorn, LaCygne, and Montrose plants. Using results of the test program, different mixes of fly ash and aggregate were selected for each of the plant sites. In addition, a test program was conducted to identify an effective set retarding agent for the mixes utilizing Type C fly ash. This paper discusses the results of the laboratory testing, the factors considered in the evaluation of the fly ash-aggregate mixes, and the design criteria for the armor-coat ditch liner to meet the specific requirements at each site. Engineering observations, evaluation of specified construction requirements, and recommendations for future installations which were gained during the construction and post-construction periods are presented. Performance of the fly ash ditch liner material is discussed including its ability to provide the structural strength to support heavy equipment which operates in the ditches to remove coal sediment which erodes from the coal piles. Type C fly ash based ditch liner has been installed resulting in substantial cost savings over Portland cement - aggregate liner mixes. 1 reference, 5 figures, 6 tables.

7171 (EPRI-CS—5362-Vol.2, pp 34.1-34.13) **Superplasticized high-volume fly ash system to reduce temperature rise in mass concrete.** Sivasundaram, V.; Carette, G.G.; Malhotra, V.M. (CANMET, Energy, Mines and Research Canada, Ottawa, Ontario). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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This paper present the results of an investigation carried out at CANMET to develop concretes incorporating high volumes of low-calcium fly ashes to reduce temperature rise in mass concrete, and describes a field application of this concrete. A number of concrete mixture incorporating high volumes of low-calcium fly ash, superplasticizer, and air-entraining admixture were made and tested, in order to obtain a workable concrete with the required mechanical properties at 91 days. A block measuring 5 x 5 x 5 ft. was cast from this concrete, under controlled ambient and placing temperatures in the laboratory, to monitor the temperature rise due to the hydration of cementitious materials. The measured temperature rise in the block was found to be close to the predicted temperature rise, and no thermal cracks developed in the block. Compressive strength and modulus of elasticity measurements obtained from cast cylinders at 3, 7, 28, 91 days, and 91- and 365-day cores from the block gave excellent results. A field application of this concrete took place in March 1987, when a seismic mass concrete block, measuring 29 x 24 x 9 ft., was cast under controlled temperature conditions at the Communications Research Center in Ottawa. The seismic mass did not develop any observable thermal cracks, and reached compressive strength and modulus of elasticity values comparable to the previous results. Thus, the superplasticized high-volume fly ash concrete performed satisfactorily in the laboratory investigations as well as in the field application, and appears to have great potential for massive structural applications. 3 references, 2 figures, 5 tables.

7172 (EPRI-CS—5362-Vol.2, pp 35.1-35.11) **Fly ash utilization in Shanghai, China.** Gu, Z.Z.; Lu, J.G.; Wang, F.Y. (Shanghai Research Institute of Building Sciences, China). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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About 200,000 tons of fly ash are currently being produced at the five coal-fired power plants in the Shanghai region and nearly 75 percent of this is used. Chemical, physical, and mineral properties of the fly ash are given. The ash has four main uses: walling material, cement additive, concrete admixture, and road construction. Each of these applications are described. 12 references, 2 figures, 10 tables.

7173 (EPRI-CS—5362-Vol.2, pp 36.1-36.16) **High replacement influence of fly ash on the air void system of concrete.** Bergeson, K.; Demirel, T.; Schlorholtz, S.; Zimmerman, L. (Iowa State Univ., Ames). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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For highway construction, the Iowa Department of Transportation (IDOT) currently limits Class C fly ash replacement for cement to 15% by weight. In order to provide a sound engineering basis for increasing fly ash replacement levels, several research problems had to be addressed. One question concerning durability regarded the influence of fly ash on the air void system of hardened concrete. In particular, its influence on the size and distribution of the entrained air void system at varying replacement levels. To investigate the influence of varying replacements of a Class C fly ash on the durability behavior of concrete, a research program was initiated using the following materials: type I portland cement, Alden and Montour crushed limestone, IDOT standard concrete sand (Bellevue source), Port Neal #4 Class C fly ash at 0, 30, 50, 70, 90% replacements by weight, and three different commercial ASTM C-260 air entraining agents. A total of 30 concrete mixes were prepared for strength, freeze-thaw durability, mercury porosimetry, and air void system analysis. This paper gives and discusses test results. 4 references, 7 tables.

7174 (EPRI-CS—5362-Vol.2, pp 37.1-37.10) **Freeze-thaw durability of fly ash concrete.** Drahushak-Crow, R. (Bureau of Reclamation, Denver, CO). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The evaluation of the effect of fly ash on freeze-thaw durability of concrete was part of a fly ash research program conducted by the Bureau of Reclamation's Concrete and Structural Branch. The total study, which will be published at a later date, also included the effect of fly ash on the compressive strength, sulfate resistance, and alkali reactivity of concrete. The objective of the study was to examine the effect of several fly ashes representing a range of calcium oxide contents at different replacement percentages of portland cement on the freeze-thaw durability of concrete. The quantity of fly ash used varied from 10 to 100% by weight of the total cementitious materials (cement plus fly ash). Comparisons with control mixes are made, and the test results are discussed with regard to type of ash, quantity of ash used, and strength-gaining characteristics. 4 references, 3 figures, 4 tables.

7175 (EPRI-CS—5362-Vol.2, pp 38.1-38.15) **Fly ash utilization as an extender in plastics and paints.** Jablonski, G.J. (American Electric Power Service Corp., Columbus, OH). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The Ash Utilization and Research Section of American Electric Power (AEP) has been actively researching new and promising high-volume utilizations of fly ash for many years. One of the most interesting and promising utilizations is that of fly ash as an extender in plastics and paints. This paper presents a test program sponsored by AEP, three manufacturers and a testing laboratory. The results of this program show that fly ash substantially decreases torque in plastic extruders, gives good surface finishes with plastics and primers, and has hiding power that is equivalent to titanium dioxide in paints. The results of this test program and the promising market potential, encourage further research into this utilization. 5 references, 1 figure, 8 tables.

7176 (EPRI-CS—5362-Vol.2, pp 38.A.1-38.A.15) **Direct acid leaching of fly ash: recovery of metals and the use of residues as fillers.** Hemmings, R.T.; Berry, E.E.; Golden, D.M. (Ontario Research Foundation, Mississauga). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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A study has been made of resource recovery of aluminum, iron and filler values by direct acid leaching (DAL) of coal fly ash from Plant Brown, Georgia. Pretreatment of the ash by size-classification, carbon removal and magnetic separation was investigated, and various fractions were leached in the laboratory with hydrochloric acid. Material balances for acid soluble components and solid residues were developed. A non-magnetic, fine-sized fraction of the ash was leached on a batch pilot scale. Extractability of aluminum from the Plant Bowen ash found to be similar to that from other low-Ca ashes. The value of pre-leach beneficiation in improving product yields and reducing load on downstream processing was demonstrated. The solid residue from batch pilot-scale leaching was processed into three filler-sized fractions from which composites were prepared in polypropylene and Nylon 6/6 matrices. The mechanical properties of the resulting composites compared well with commercial non-reinforcing fillers. The spherical DAL-fillers were particularly effective in improving the flow properties of thermoplastic resins during molding. Brightness of the fillers was poor, and they produced dark-colored composites. 13 references, 7 figures, 4 tables.

7177 (EPRI-CS—5362-Vol.2, pp 39.1-39.14) **Recovery of cenospheres and application to the manufacture of insulation materials.** Yih, S.M.; Kuo, S.T.; Tu, C.H.; Quo, L.W. (Chung Yuan Christian Univ., Chung Li, Taiwan). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The objectives of this study are: (1) how to recover floaters on the surface of the ash lagoon; (2) to separate the dry cenospheres which constitute a large portion of fly ash by means of fluidized classification method; (3) to identify the physical and chemical properties of floaters and dry cenospheres; and (4) to apply the cenospheres in the manufacture of PVC insulating material and EVA foam. The results showed that fly ash from Lin Kow power plant contains 0.3 wt% of floaters. Its particle size distribution concentrates within 100 to 200 mesh size which occupied about 84% of the total amount of floaters. Using an air velocity of 5.9 cm/s in a 12 cm diameter, 100 cm height fluidized bed, about 50 to 60 wt% of dry cenospheres were screened out. The particles were quite uniform and nearly all pass the 325 mesh screen ($< 45\ \mu m$). The effects were quite promising when dry ash cenospheres were added to replace the talc present in 5% of the mixture used to synthesize PVC insulating material and to completely replace the high percentage calcium carbonate present in the mixture used to synthesize EVA foam. Material testing of the products showed the strength and insulation properties competitive to the traditional products. However, the effect of adding floaters or fly ash in both cases are not good or a little bit worse. The above results showed that, dry cenospheres have great potential in replacing the talc and calcium carbonate as filler of insulating or plastic materials. 6 references, 6 figures, 6 tables.

7178 (EPRI-CS—5362-Vol.2, pp 40.1-40.12) **Proposed utilization of atmospheric fluidized bed combustion waste in the production of Portland cement and sulfuric acid.** Finch, R.C.; Salladay, D.G.; Weiss, S.J. (Tennessee Valley Authority, Muscle Shoals, AL). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Studies have indicated that it is technically and economically feasible to produce Portland cement and sulfuric acid from atmospheric fluidized bed combustion (AFBC) waste. Ongoing, relatively stable markets exist for both Portland cement and sulfuric acid. Current Portland cement consumption in the US is 88 million tons per year, while sulfuric acid consumption is about 40 million tons per year. These studies were conducted for a 500-megawatt (MW) AFBC unit base case and also for the 160-MW AFBC unit now in the final phases of construction at Paducah, Kentucky. Currently, the AFBC Development Corporation, which is constructing this 160-MW unit, is funding laboratory studies by Construction Technology Laboratories, Inc., Skokie, Illinois. Although European technologies produced Portland cement from mined gypsum 20 years ago, the technology to produce Portland cement from AFBC waste, limestone, and gypsum is not yet developed and demonstrated. This paper discusses the formulation parameters and constraints which must be met to produce Portland cement from AFBC waste. 1 figure, 3 tables.

7179 (EPRI-CS—5362-Vol.2, pp 41.1-41.15) **Application of high fly ash concrete to large artificial fish reefs.** Nagataki, S.; Ohga, H.; Shimomura, Y.; Taniguchi, K. (Tokyo Institute of Technology, Japan). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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Most of the fly ash produced in Japan is disposed of in fields or nearshore areas. However, disposal areas are subject to limitations due to environmental restraints and shortage of open spaces. Therefore, it is necessary for means of effectively using large amounts of fly ash to be found. The effect of a chemical activator on the strength of concrete containing a large amount of fly ash, named high fly ash concrete, is evaluated in this study. High fly ash concrete is made of Class F fly ash (54%), cement (15%), water (20%), sand (10%), and a newly-developed chemical activator (1%), percentages given being by weight. Its strength is more than 30 MPa (4350 psi) at 28 days. Resistance of high fly ash concrete to sea water attack is also studied using XRD, SEM, and EPMA. High fly ash concrete shows good resistance to attack by sea water. Based on the results obtained, large artificial fish habitats, or reefs, each 52 tons in weight, 2.5 m in height, and 7.6 m in diameter are made with high fly ash concrete and placed at the bottom of the sea for 3 years. The fish reefs are confirmed to be very effective in attracting many kinds of fishes. In particular, squid and octopus laid eggs in the reefs. High fly ash concrete can be used for large-scale artificial mountain ridges on the bottom of the sea. The artificial ridges are expected to help promote use of coal-fired thermal power plants and improve fishing resources in the sea. 3 references, 7 figures, 10 tables.

7180 (EPRI-CS—5362-Vol.2, pp 42.1-42.6) **Simulated fireplace logs manufactured with fly ash.** Bergeson, K.; Demirel, T.; Schlorholtz, S. (Iowa State Univ., Ames). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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An Iowa firm had negotiated a contract with a national retailer to manufacture free standing metal fireplaces to burn canned fuel. As a part of that contract the manufacturer was also required to provide a set of two simulated wood logs with each fireplace. The firm's engineer had developed a prototype metal log form, in the shape of a half cylinder, approximately 18 inches in length and 4 inches in diameter. This form was lined with a thin silicone based material that had been cast from a real wood log to provide the desired simulated log texture. Initial in-house production, by the manufacturer, of prototype logs using a conventional sand and cement mortar mix resulted in excessive curing times before molds could be stripped. The cured logs also exhibited severe shrinkage crack development. Since mold cost was expensive and the contract production requirements were substantial, a research program was initiated to develop a log mix formulation that would facilitate production and meet the desired physical requirements. This paper describes the laboratory studies of mixtures of Class C fly ash, cement, retardants, and superplasticizers and the successful manufacture of simulated logs. 1 reference, 2 tables.

7181 (EPRI-CS—5362-Vol.2, pp 43.1-43.13) **Geotechnical challenges associated with increasing the storage capacity of a coal ash lagoon.** Chan, H.T.; Cragg, C.B.H. (Ontario Hydro, Toronto). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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Ontario Hydro's 400-MW Nanticoke coal-fired generating station employed wet disposal of coal ash to an 186-acre on-site lagoon during the period from 1972 to 1981. Since 1981, a scheme to stack the ash to greater heights within the lagoon site has been implemented in order to extend the capacity and life of the lagoon. Several geotechnical problems have arisen as the result of this new ash management practice. The paper describes the design, operation and geotechnical performance of the lagoon during its entire life, to date, with emphasis on the geotechnical problems and adopted solutions involved in changing the ash stacking method. The problems include: stability of slopes founded on loose ash, use of ash for water retaining dykes, ability of lagoon ash to support construction vehicles, dust control, seepage, winter operation and design of the long-term ash storage mounds. It was concluded from this case study that the lagoon at the Nanticoke station is an efficient and useful ash storage facility. The engineering solutions to the geotechnical problems at the lagoon should be of benefit to other engineers who consider the use of a lagoon for ash storage. 1 reference, 5 figures.

7182 (EPRI-CS—5362-Vol.2, pp 44.1-44.18) **Computer-aided design approach for fly ash landfills.** Chan, H.T.; Sykes, J.F.; Ash, P.O. (Ontario Hydro Research Division, Toronto). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The paper first describes a ground water case study at a landfill site, which was reclaimed from an abandoned sand pit using fly ash as a fill material. Secondly, with use of the ground water data obtained at the site from 1978-85, the versatility of a computer model as a landfill design tool is demonstrated. Several factors affecting the impact of a fly ash landfill on the quality of the ground water system were investigated, including (1) the location of the ash fill with respect to the water table, (2) the amount of infiltration through the fill, and (3) the hydraulic conductivity of the geologic material on which the ash overlies. It was concluded that the designer of an ash landfill must be aware that a landfill is a system containing many components, which should be considered together to obtain the most efficient landfill design. The use of computer modeling is particularly valuable in this respect. 11 references, 14 figures.

7183 (EPRI-CS—5362-Vol.2, pp 45.1-45.12) **Landfill procedures for coal ash surplus: permanent disposal sites or storage for utilization.** Mullin, P.E. (Stanley Consultants, Washington, DC). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The beneficial use of coal combustion residues is increasing. These residues include fly ash and bottom ash from the burning of coal and flue gas desulfurization (FGD) sludge from the efforts to reduce air pollution. However, there are still many constraints to their beneficial use. There is currently more material than can be used. Therefore, the large quantity of fly ash, bottom ash, and FGD sludge must be handled, disposed of, and/or stored in an environmentally acceptable manner. When the demand for these residues increase, they can be mined from their storage sites. Two projects discussed here illustrate environmentally acceptable methods for handling and disposal of and/or storage of coal combustion residues. 4 figures.

7184 (EPRI-CS—5362-Vol.2, pp 46.1) **Environmental regulations governing power plant ash utilization and disposal.** Kinder, D.L.; Chumley, J.W.; Fisher, B.C. (KBK Enterprises, Inc., Marietta, GA). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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This paper provides examples of how power plant ash is presently being regulated by various state agencies for disposal and reuse applications. Examples are cited to show the wide range of variation for states from different parts of the country and to demonstrate the positive and negative influence these regulations can have on reuse applications. Environmental concerns for the disposal and reuse of power plant ash on specific projects are presented. The methodology and resulting solutions for each of the environmental considerations for a specific project are addressed. The economical impact on these projects is also covered. This paper shows the environmental concerns from state agencies across the country are not that different but many of the existing regulations from various states do not take into consideration present day technology for handling coal combustion by-products.

7185 (EPRI-CS—5362-Vol.2, pp 47.1-47.13) **Development of fly ash liners for waste disposal sites.** Moretti, C.J.; Wentz, C.A.; Wiken, K.W. (Univ. of North Dakota Energy Research Center, Grand Forks). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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New landfill facilities are often required to construct liner systems to contain leachates and protect ground water. Liner construction may significantly increase waste disposal costs if suitable clay soils are not present at the disposal site. A cost-effective alternative to conventional liners, particularly for coal fired utility plants, is the use of fly ash for liner construction. A series of experiments were conducted with six different types of fly ash wastes to determine whether they can be used to produce stable, low permeability liner materials. To date, this research has generated encouraging results which indicate that acceptable liner materials can be made from fly ash. Each of the six fly ashes was initially tested for selected chemical and physical properties related to their use for liner materials. Parametric tests, referred to as scoping tests, were performed in which different amounts of water were added to liner mixtures containing fixed levels of time, cement and fly ash to determine the approximate amounts of additives required to produce acceptable liners. Based on the results of the scoping tests, designed laboratory experiments were conducted using variable additive levels to develop specific formulas for producing liner materials from the fly ashes. This paper reviews the use of fly ash for liner construction. The experience gained from the liner research performed at UNDERC is discussed, and critical questions concerning liner additives, permeability and stability characteristics, additive costs and potential environmental impacts are evaluated. 5 references, 5 figures, 2 tables.

7186 (EPRI-CS—5362-Vol.2, pp 48.1-48.23) **Corrosiveness of power plant ashes.** Jablonski, G.J.; Aliff, O.E. (American Electric Power Service Corp., Columbus, OH). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The reason for embarking on this study was to overcome a major deterrent to power plant ash utilization. The deterrent has been a lack of knowledge of the potential corrosiveness of power plant ashes. This has affected power plant ash sales in utilizations of structural fill, backfill, and pipe bedding. Knowing that power plant ashes differ in characteristics from plant to plant and given the distinct differences between the three types (fly ash, bottom ash, boiler slag), the objective of the study was to determine if the various types of power plant ashes are corrosive and if so, to what extent; and to develop a simple laboratory test to enable evaluation of, or to predict, ash corrosiveness. The research study was organized into two phases. A laboratory phase (part I and part II) and field demonstration phase (part I and part II). To date, results have shown that power plant ashes, in most instances, are no more corrosive than sand or soil. However, this paper is an interim presentation of the observations and conclusions during the first 24-months of the research study. Conclusions provisionally stated herein are subject to modifications upon receipt of additional data. 8 figures.

7187 (EPRI-CS—5362-Vol.2, pp 48.A.1-48.A.16) **Effects of fly ash and bottom ash fills on embedded concrete.** Hooton, R.D. (Ontario Hydro, Toronto). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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It is known that sulfates can be leached from both fly ash and bottom ash when used as fill materials and this could potentially cause sulfate attack on adjacent or embedded concrete foundations. In the laboratory study, mortar bars, made with high and moderate and low $C_3A$ cements or with fly ash or slag blends, were exposed to 2000 mg/1 $SO_4$ solutions of sodium sulfate, fly ash (Class F) leachate and lime water for 7 years. In addition, for the first 20 months, the bars were wet and dry cycled daily in an attempt to accelerated deterioration. The results to date indicate that exposure to fly ash leachate is not nearly as severe as the sodium sulfate solutions. The field trials involved casting both air and non-air entrained concrete prisms made with high and low $C_3A$ cements and with a fly ash blend. Half of the prisms were buried below the

water table in either bottom ash, Class F fly ash or natural granular fills. The other prisms were half-buried vertically in the same three fill materials so they would be subject to freezing and thawing as well as wetting and drying. The prisms were placed in 1982 and were dug out, measured (visual, length, mass and ultrasonic pulse velocity) and re-buried after 1 and 3 years exposure. Future measurements will be made at 3-year intervals. To date, results indicate that the fly ash fill material is not very aggressive to any of the concrete prisms. However, the bottom ash is starting to deteriorate many of the concrete prisms which were buried below the water table. The deterioration takes the form of softened and cracked corners and edges and may be attributable to the acidity (pH = 4) of the bottom ash leachate rather than the sulfates. 7 references, 4 figures, 4 tables.

7188 (EPRI-CS—5362-Vol.2, pp 48.B.1-48.B.9) **Reinforced pulverized fuel ash retaining wall performance: polymer reinforcement in fly ash bulk fill.** Sarsby, R.W. (Bolton Institute of Higher Education, England). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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The Dewsbury inner ring road connects with, or passes over, the arterial roads which lead into the town center and because of the local topography the scheme involves the construction of a number of retaining walls. As a result of the successful erection and loading of a trial wall, County Authority (West Yorkshire) opted to build retaining walls composed of Pulverized Fuel Ash (PFA) reinforced with a non-metallic grid (Tenser SR2). Since this was a novel form of construction a research contract was awarded for the instrumentation and performance monitoring of two of these walls. The scope of the research program was further widened by the Transport and Road Research Laboratory who arranged a variation to the contract for Town Hall Wall so that it contained three different types of non-metallic reinforcement. The broad objectives of the research program are: 1) to obtain information on the stresses and strains which occur during erection of the retaining walls and compaction of the fill; and 2) to monitor changes in the pressures and displacements with time, particularly after the ring road has been opened to traffic. Since non-metallic reinforcement is being utilized possible creep behavior or the structures is of particular interest. In addition the gain in strength of the PFA, due to aging, may have a significant influence on the long-term behavior of these walls. This paper describes wall construction, instrumentation, and performance data. 4 references, 7 figures.

7189 (EPRI-CS—5362-Vol.2, pp 49.1-49.13) **Recirculating sand filters using bottom ash and boiler slag.** Usmen, M.A.; Dix, S.P.; Sack, W.A. (West Virginia Univ., Morgantown). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

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Laboratory and field studies undertaken at West Virginia University on the use of boiler slag and bottom ash as aggregates in recirculating sand filter (RSF) systems for septic tank effluent treatment are described in this paper. The findings indicate that both materials perform excellently in RSF systems, and it may be possible to achieve acceptable performance with unscreened/unprocessed bottom ash without satisfying the existing specification criteria for conventional media. 4 references, 3 figures, 4 tables.

7190 (EPRI-CS—5362-Vol.2, pp 50.1-50.10) **High-volume ash utilization in roadways, embankments, and backfills - an update.** DiGioia, A.M. Jr.; Golden, D.M. (GAI Consultants, Inc., Monroeville, PA). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

This paper describes the current status of a five-year Electric Power Research Institute project which is directed towards increasing ash utilization in high-volume uses on a national basis. The project was previously described in a paper presented at the Seventh International Ash Utilization Symposium. Since the presentation of the initial paper, several information reports and design manuals have been completed and are now available to design engineers, contractors, ash marketers and others interested in ash utilization. This paper describes the significant features of these publications and outlines the remaining tasks of the project. 4 references, 2 figures.

7191 (EPRI-CS—5362-Vol.2, pp 51.1-51.14) **Evaluation of stabilized fly ash materials for use in liner and pavement applications.** Usmen, M.A.; Bowders, J.J. Jr.; Gidley, J.S. (West Virginia Univ., Morgantown). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Two Class F ashes from West Virginia were evaluated for feasibility of use as a liner or stabilized base course material. Index, compaction, strength, durability, permeability, and leachate properties were evaluated. It was found that stabilized fly ash holds good promise for use in pavement bases but since its permeability is higher than $10^{-7}$ cm/sec (it is on the order of $10^{-6}$ cm/sec), its use may be limited to canals, reservoirs, cut-off structure and solid waste landfills. It was also found, however, that bentonite addition lowers the permeability to the desired range for application in hazardous waste landfills. This formulation is under further investigation. 17 references, 2 figures, 4 tables.

7192 (EPRI-CS—5362-Vol.2, pp 52.1-52.11) **Recycling pavements with self-cementing fly ash.** Ferguson, E.G. (Terracon Consultants SE, Inc., Lenexa, KS). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Use of self-cementing (Class C) fly ash for stabilization purposes has expanded in recent years and has increased the authors understanding of the material. This background on the self-cementing fly ash and its hydration products has allowed the implementation of new and innovative applications including the rehabilitation of pavements. The recycling process consists of pulverizing the entire pavement section, incorporating sufficient quantities of Class C fly ash and water, and compacting the mixture. The stabilized section then functions as a pavement base course section and requires the application of wearing surfaces consisting of a chip and seal or an asphaltic concrete surface course. The process is intended to allow recycling of asphaltic bound materials and granular material contaminated by subgrade soil that are unsuitable for recycling by conventional procedures and have inadequate stability in their present condition. The process is directed at roadways having less than four inches of asphaltic bound materials at the surface and having aggregate bases of variable composition and quality. Applications are limited primarily to county and municipal roadways having relatively light traffic volume yet which constitute the major portion of the infrastructure. 3 figures, 2 tables.

7193 (EPRI-CS—5362-Vol.2, pp 53.1-53.9) **Field demonstration project for class "C" fly ash - dry retarder base course.** Kraft, D.C.; Valencia, J. (Univ. of Kansas, Lawrence). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

ASTM has defined the difference between Class F and Class C fly ash based on their respective chemical composition ranges. The major difference, however, is that Class C fly ash exhibits self-cementing characteristics whereas Class F fly ash does not. While the self-cementing feature of Class C fly ash is desirable, it is accompanied by a very short time to initial set. In some cases this initial set can occur within 5 to 10 minutes. Consequently, when Class C fly ash is used as an engineering material, a retarder must often by used to delay the time to initial set. This paper details the use of

a Class C fly ash-dry retarder blend which was combined with an aggregate to produce a base course for a road demonstration project conducted on July 29 and 30, 1986. A description of the production of the blend and base course mix design along with the details of construction and evaluation of the base course is given below. The objective of the demonstration project was to determine if the Class C fly ash-dry retarder blend provided a suitable delay time in initial set during construction and to verify projected compressive strength gains in the base course as well as to iron out details in the construction procedure. 1 reference, 4 figures, 4 tables.

7194 (EPRI-CS—5362-Vol.2, pp 54.1-54.13) **Commercial activity in roadbase construction utilizing fly ash-fixated flue gas desulfurization sludge.** Smith, C.L.; Colella, J.W. (Conversion Systems, Inc., Horsham, PA). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

There are at present some 142 operating flue gas desulfurization scrubbers on coal burning power plants; nearly all producing a waste product requiring some form of environmentally safe disposal. Thus far, in thirty locations, environmental constraints have required that FGD sludge be stabilized via chemical reaction into an innocuous monolithic mass. Another paper at this symposium describes the Poz-O-Tec process, a blending of FGD sludge, fly ash and lime, the environmental protection that it yields, and the locations in the US where the process is being utilized. For the purposes of the present discussion, it is sufficient to say that the disposal of scrubber sludge via this process, entails use of pozzolanic and sulfo-pozzolanic chemistry, and the cementation entailed in those processes. The product is environmentally desirable and represents a resource. The disposal of some forty million tons of fly ash-scrubber sludge-lime composition annually represents a significant loss of reusable resources. The objective of this paper is to discuss the present commercial status of utilizing the material asa pozzolanic roadbase. 2 figures, 5 tables.

7195 (EPRI-CS—5362-Vol.2, pp 55.1-55.12) **Utilization of pulverized fuel ash and fluidized bed combustion ash in AFBC concretes.** Jones, C.E.; Bland, A.E.; Rose, J.G.; Jarrett, M.N. (Kentucky Energy Cabinet Lab., Lexington). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The Tennessee Valley Authority and the Kentucky Energy Cabinet have been sponsoring research into the production of AFBC concretes made with coal combustion ashes. Atmospheric fluidized bed combustion (AFBC) spent bed (SB) ash and pulverized fuel ash (PFA) were substituted for river sand and cement in the production of AFBC concrete. PFA and SB are both required to provide the pozzolanic reactions necessary for strength development. Moreover, the SB has the granular consistency of a fine aggregate and serves as a total replacement for river sand. However, a preconditioning step (prehydration) of the SB is required to control heat release and molar volume expansion. AFBC concretes have been produced with performance characteristics comparable to conventional Portland cement concretes. Compressive strengths in excess of 5000 psi at 60 days curing time were recorded. In addition, the AFBC concrete exhibited a low modulus of elasticity as well as controlled expansion characteristics. Typical of concretes containing PFA, setting times were increased for AFBC concretes. A wide range of demonstrations of the use of AFBC concrete are presently underway. These include commercial concrete slabs, masonry units for mine ventilation applications, and road base structural layers. The demonstrations have been successful, indicating that commercial use of AFBC concretes is promising. 13 references, 5 figures, 2 tables.

7196 (EPRI-CS—5362-Vol.2, pp 56.1-56.21) **Utilization of fuel ash in the manufacture of autoclaved cellular concrete building materials.** DeVore, P.; Mounkurai, T. (West Virginia Univ., Morgantown). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

West Virginia undertook a study to determine the feasibility of establishing an autoclaved cellular concrete building products plant in the state. The concrete product would make use of the fly ash produced in the state's coal-fired power plants. The paper first describes the characteristics of autoclaved cellular concrete: density, compression strength, thermal properties, sound absorption, fire resistance, and frost resistance. The paper then discusses production of the concrete, construction using precast concrete components, manufacturers of this type of building product, the economics of an autoclaved cellular concrete plant in West Virginia, and marketing the product. 13 references, 4 figures.

7197 (EPRI-CS—5362-Vol.2, pp 57.1-57.7) **Aardelite - an economical lightweight aggregate from fly ash.** Hay, P.; Rademaker, P.D. (Progress Materials, Inc., St. Petersburg, FL). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

Aardelite is a man-made lightweight concrete aggregate which uses fly ash as its principal constituent. The product is particularly suitable as coarse aggregate in lightweight concrete masonry units, where its high quality and low cost make it extremely competitive with traditional aggregates. Aardelite aggregate can be produced from fly ash that is not otherwise saleable as pozzolan replacement - either because of poor quality of the fly ash or because of market saturation. Aardelite achieves its competitive edge through process technology that economically produces high quality granulates. By exploiting fly ash's pozzolanic properties, the process operates at close to ambient temperatures, thereby requiring minimal capital and operating costs. Fly ash is mixed with lime, water, and proprietary additives. The mixture is pelletized, cured, and sized on a continuous basis. The process is energy-conservative, using only modest amounts of low pressure steam for controlled and rapid curing. In less than sixteen hours from fly ash entering the plant, Aardelite aggregate is ready for shipment and use. The main purpose of this paper is to introduce Aardelite aggregate to those organizations having significant quantities of fly ash that are presently non-saleable. In interest of brevity, detailed information of particular interest to potential Aardelite aggregate users has been condensed and summarized.

7198 (EPRI-CS—5362-Vol.2, pp 58.1-58.12) **Fly ash lightweight aggregate: the Agglite process.** Styron, R.W. (Resource Technology, Inc., Tucker, GA). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The lightweight aggregate (Agglite) is essentially a hardened agglomerated mixture of either Class C fly ash or combinations thereof, a surfactant foam, dry catalyst, accelerators and Portland cement. Portland cement was selected because it is cheaper than lime, is readily available and produces quick reliable strengths without further temperature curing, such as dry or wet kilns. This paper gives results of tests on the individual pellets and on concrete block produced with Agglite. The remainder of the paper discusses the market potential for a lightweight aggregate and the economics of an Agglite production plant. 2 figures, 6 tables.

7199 (EPRI-CS—5362-Vol.2, pp 59.1-59.9) **Bricks from lignite fly ash.** Baradan, B. (Dokuz Eylul Univ., Izmir, Turkey). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

To fulfill the expanding energy demands, Turkey has to evaluate her low-calorie lignite potential in electric power plants. To prevent air pollution caused by the electricity generation, electrostatically precipitated fly ash accumulates daily both in local areas and throughout the world. This size of by-product creates serious environmental, technical and economical problems that need to be solved. Samples of fly ashes from Soma-B thermal plant were tested to evaluate their potential for brick productions. The properties of fly ash-bottom ash and fly ash-volcanite mixes stabilized with cement and lime were investigated. Most of the compositions proved to be promising and economical due to the lightweight and low thermal conductivity properties and low cost of the mixes. 4 references, 4 figures, 4 tables.

7200 (EPRI-CS—5362-Vol.2, pp 60.1-60.19) **Utilization of lignite and subbituminous combustion ashes, slags, and scrubber sludges and gasification ashes in a variety of commercially viable products.** Manz, O.E. (Univ. of North Dakota, Grand Forks). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2).

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The University of North Dakota, in addition to research involving western fly ash in concrete, has been investigating the use of combustion and gasifier ashes in products such as sulfur concrete, mineral wool, high flexural strength ceramics, blended cement, road base stabilization and high percent replacement of portland cement with certain fly ashes. Where possible, ASTM fabrication and testing procedures were used. Mineral wool of similar physical character to commercial wool and at lower potential cost was produced using 100% of various western ashes. Sulfur concrete utilizing 80% ash and 20% modified sulfur developed flexural and compressive strengths in excess of 2250 and 5000 psi, respectively. An economically competitive vitrified ceramic product with flexural strength above 7800 psi was produced from a mixture of 50% ash, 45% sand, and 5% clay. By using a total ash mixture of 26% gasifier ash and 74% combustion ash, a very satisfactory, economical and durable roadbed material was developed. The replacement of up to 50% of the cement in concrete with western fly ash produces economical, high strength concrete. Ceramic glazed wall tile that utilize fly ash in place of clay have been prepared and shown to meet most specifications for fired clay tile. Both fired and unfired dry-pressed brick containing 100% western fly ash have met ASTM specifications fired clay brick. There has been field verification of successful use of fly ash for: road base stabilization; for as much as 75% replacement of cement in concrete; for forming of mineral wool below a power plant cyclone boiler; and forming of 40 foot power poles containing 50% fly ash. 17 references, 11 tables.

7201 (EPRI-CS—5362-Vol.2, pp 61.1-61.17) **Experimental studies of the production of lightweight aggregate from fly ash/coal cleaning refuse mixtures.** Burnet, G.; Gokhale, A.J. (Ames Lab., IA). Oct 1987. NTIS, PC A 20 - Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE88000540/JAW. (CONF-8710155—Vol.2). Contract W-7405-ENG-82.

From 8. international ash utilization symposium; Washington, DC, USA (28 Oct 1987).

The production of lightweight aggregate offers an attractive opportunity for the high volume utilization of fly ash. Lightweight concrete has become an important structural material because of the practical and economic advantages it possesses. The demand for it is increasing and could be expanded by the availability of high quality lightweight aggregate at a reasonable cost manufactured from coal cleaning and combustion wastes. In this work, a granulation/sintering process has been developed for the manufacture of a lightweight aggregate from coal cleaning refuse and fly ash. The resulting granules have the properties required of a lightweight aggregate. It is important to note, however, that while these properties can be measured and evaluated, it is difficult to identify a good aggregate other than by showing that it can be used to make good concrete. Tests on the aggregate alone are helpful in assessing its suitability, but the final criterion must be performance in concrete. This evaluation remains to be done for the refuse/fly ash aggregate. 13 references, 5 figures, 4 tables.

7202 **(ICEAS-B—5) FGD handbook: Flue gas desulphurisation systems.** Klingspor, J.S.; Cope, D.R. (International Energy Agency Coal Research, London (UK)). May 1987. 258p. NTIS (US Sales Only), PC A12/MF A01. Order Number TI88002993/JAW.

The handbook provides basic information on over one hundred FGD systems for control of sulfur emissions from coal-fired boilers. The full range of the gas desulfurization systems is included, as well as systems offering simultaneous control of sulfur and nitrogen oxide emissions. Information is provided on the system reagent requirements, the nature of the FGD by-product, and process characteristics such as sulfur dioxide removal levels. Furthermore, information on the status of the FGD processes is also included. For less well known systems and processes in an early development stage, a short process description has been added.

7203 **(PB—88-102991/XAB) Fundamental processes involved in $SO_2$ capture by calcium-based adsorbents.** Gullett, B.K.; Kramlich, J.C. (Energy and Environmental Research Corp., Irvine, CA (USA)). Sep 1987. 16p. NTIS, PC A03/MF A01.

This paper discusses the fundamental processes in $SO_2$ capture by calcium-based adsorbents for upper furnace, duct, and electrostatic precipitator (ESP) reaction sites. It examines the reactions in light of controlling mechanisms, effect of sorbent physical properties, and important process variables. Upper furnace reactivity is limited to 900-1200 C by rate and equilibrium constraints, respectively. Sulfation is a function of in-situ sorbent characteristics of porosity, particle size, and surface area. Conversion of the sorbent is ultimately limited by the formation of the calcium sulfate ($CaSO_4$) product layer. The in-duct reaction is accomplished through sorbent scavenging in the flue-gas stream by a water spray. The scavenging efficiency of the sorbent by the water droplets limits the process, while reaction is controlled by the dissolution rate of the sorbent. The E-SOX process in a modified ESP simulates a short time spray dryer through injection of a $Ca(OH)_2$ slurry. The $Ca(OH)_2$ undergoes aqueous phase reaction to remove $SO_2$. Evaporation of the droplets prior to the ESP field conditions the flue gas for more-efficient particulate-matter collection by lowering the gas resistivity.

## 0109 Environmental Aspects

*REFER ALSO TO CITATION(S) 7163, 7164, 7165, 7167, 7168, 7184, 7191, 7213, 7214, 7230*

## 0120 Mining

*REFER ALSO TO CITATION(S) 7135, 7229, 7229, 7230*

7204 **(PB—87-231395/XAB) Assessment of longwall-roof behavior and support loading by linear elastic modeling of the support structure. Report of Investigations/1987.** Barczak, T.M.; Burton, W.S. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 14p. (BM-RI—9081). NTIS, PC A02/MF A01.

Also available from Supt. of Docs., Library of Congress catalog card No. 86-607949.

Longwall-roof behavior is characterized by strata displacements in both the face-to-waste (horizontal) and roof-to-floor (vertical) directions. The roof-support structure provides resistance to this motion by translation of these displacements into vertical and horizontal support loading. Observations indicate that the shield reacts with both a vertical and horizontal force to uniaxial convergence (displacement). However, there are different magnitudes depending on whether the displacement is vertical or horizontal. This makes it possible to use supports as monitors of strata activity and loading. The Bureau of Mines examined this behavior using a linear elastic model of the support structure with two degrees of freedom. Vertical and horizontal load reactions were related to associated

displacement actions of the strata. This was done by determining the stiffness of the shield under controlled vertical and horizontal displacement motions in the Bureau's mine roof simulator. The report provides example predictions of strata convergence and isolation of horizontal support loading due to vertical roof convergence using the linear elastic shield model. The report also examines efforts to determine strata behavior by direct measurement of support displacement.

7205 **(PB—87-231593/XAB) Arch-canopy design procedure for rehabilitation of high-roof-fall areas. Report of investigations/1987.** Allwes, R.A.; Mangelsdorf, C.P.; Pappas, D.M. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 60p. (BM-RI—9075). NTIS, PC A04/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 86-600352.

The Bureau of Mines report presents a procedure for the design of an arch canopy for use in rehabilitating a high-roof-fall area. Only dynamic line loading of an unbackfilled arch canopy at its crown is considered, and the procedure does not account for an asymmetrical loading condition. The evaluation of whether an arch canopy is suitable for a particular installation depends on many variables, including in-mine conditions and the engineering properties of the structure. However, a general evaluation can be based on a comparison of the arch's maximum crown deflection and a prescribed allowable crown deflection. The design procedure is based on the concept that when an arch canopy is subjected to impact loading at its crown and deflects from its unloaded state to maximum crown deflection, the structure absorbs strain energy, both elastic and plastic. As a result, this strain energy can be calculated from a static load-displacement diagram for the structure. The significance of this design procedure is that it gives mine personnel an analytical tool to select an arch canopy to meet the dimensional and functional requirements of a mine entry and a prescribed allowable crown deflection.

7206 **(PB—87-231601/XAB) Stemming ejection and burden movements from small borehole blasts. Report of Investigations/1987.** Kopp, J.W. (Bureau of Mines, Twin Cities, MN (USA). Twin Cities Research Center). 1987. 22p. (BM-RI—9080). NTIS, PC A02/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 86-607912.

Stemming is used in blasting operations to help contain explosive gases as long as possible. Stemming can reduce airblast, improve fragmentation, and reduce the chances of hot explosive gases igniting methane and dust explosions in underground mines. Stemming is required in underground coal mines, but is generally not used in underground metal and nonmetal mines. Some underground metal and nonmetal mines are classified as gassy and can require special blasting procedures such as the use of stemming to insure the safety of miners. The types and amounts of stemming material that are desirable in underground metal and nonmetal mine blasting to ensure good or improved fragmentation while containing the hot gases are largely unknown. The Bureau of Mines research examined the effectiveness of differing lengths of stemming by measuring stemming ejection times as related to burden movement.

7207 **(PB—87-231619/XAB) Spontaneous-combustion studies of US coals. Rept. of Investigations/1987.** Smith, A.C.; Lazzara, C.P. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 35p. (BM-RI—9079). NTIS, PC A03/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 86-607906.

This report describes laboratory studies conducted by the Bureau of Mines on the spontaneous combustion of U.S. coals. Approximately 11 pct of U.S. underground-coal-mine fires are attributed to spontaneous combustion. The relative self-heating tendencies of 24 coal samples were evaluated in an adiabatic heating oven. Minimum self-heating temperatures (SHT's) in the oven ranged from 35°C for a lignite and high-volatile C bituminous coal, to 135°C for two low-volatile bituminous coals. The minimum SHT's of two coals were determined, and the results were in good agreement with those found in the adiabatic oven. Finally, results of a test in the moderate-scale apparatus indicated a strong dependence of the self-heating rate of a low-rank coal on the moisture content of the air.

## 0140 Combustion

*REFER ALSO TO CITATION(S) 7417, 7418, 7419, 7420, 7421, 7422, 7423, 7424, 7426, 7428, 7437, 7438, 7730, 7731, 7732, 7733, 7734, 7735, 7736, 7738, 7739*

7208 **(DOE/PC/90753—T6) Coal ash deposition, interaction with metal substrates and deposit build up: Sixth quarterly report.** Birks, N. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 1987. Contract FG22-86PC90753. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002433/JAW.

The objective of the current program remains to characterize the attack of the metal substrate subsequent to the deposition of coal ash under complex atmospheres that contain about 1% $SO_3$ and are primarily oxidizing. Such atmospheres are represented in the laboratory quite adequately by a mixture of air and 1% $SO_2$ so long as the $O_2/SO_2/SO_3$ equilibrium can be catalyzed. 24 refs., 7 figs., 2 tabs.

7209 (EPRI-CS—5186, pp 1.1-1.31) **Scope and status of EPRI research activities in atmospheric fluidized bed combustion.** Howe, W.C. Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

EPRI's Atmospheric Fluidized Bed Combustion (AFBC) research has expanded rapidly over the past several years. Since the ultimate goal is to transfer information from their research to various users, they felt it would be useful to summarize the scope of their research activities and describe the types of information either already available or forthcoming. Though their research effort focuses on the test programs at various pilot and demonstration projects, they are tailoring the test programs and subsequent information flow into common topical areas. This enables them to take best advantage of the diversity in scale and configurations of each pilot and demonstration facility in data evaluation; ensures common experimental methods and data formatting; and categorizes information into topics for use by specialists within various organizations. The test programs and research activities are therefore broken down into eleven areas as described herein. This is only intended to be a summary of each area; more information can be obtained from the individual EPRI project manager(s) listed at the end of each research activity description. Questions of a general nature can be directed to either the author or Shelton Ehrlich.

7210 (EPRI-CS—5186, pp 22.1-22.28) **Combustion characteristics of solid fuels in an AFBC unit.** Duqum, J.N.; Chandran, R.; Nayak, R.V. (Babcock & Wilcox Co., Alliance, OH). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Experiments were conducted in a 2"-diameter atmospheric fluidized-bed combustion (AFBC) unit to determine combustion profiles, fragmentation, and attrition characteristics of solid fuels. The fuels tested were Texas lignite, Sarpy Creek subbituminous coal, Kentucky no. 9 bituminous coal, and green petroleum coke. It was found that the lower rank coals of sizes typically used in AFBC units did not swell or fragment. However, the bituminous coal swelled significantly during devolatilization; for particles 1/4" and larger, swelling coupled with intraparticle thermal gradients caused fragmentation. This breakup produced a number of half shells (two to four) and a porous core, and during oxidation these shells further fragmented. Therefore, it appears that modeling chars as spheres is inappropriate.

7211 (EPRI-CS—5186, pp 25.1-25.20) **Char combustion kinetics for Kentucky No. 9 coal.** Daw, C.S.; Mitchell, R.E. (Oak Ridge National Lab., TN). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—). Contract AC05-84OR21400.

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Global burning rates were measured for char produced during laboratory combustion of Kentucky No. 9 coal and for Kentucky No. 9 char elutriated from the Tennessee Valley Authority 20-MWe atmospheric fluidized-bed combustion (AFBC) pilot plant. Low-temperature burning rates were measured with a thermogravimetric analyzer, and these data have been combined with previously thermogravimetric data and data from a fixed-sample, tubular-flow reactors. The yield has been a description of Kentucky No. 9 char combustion at temperature between 650 and 1100°K. High-temperature describe Kentucky No. 9 char combustion between 1390 and 1600°K. Comparisons of the low- and high-temperature measurements indicate that the burning rate of Kentucky No. 9 char, exclusive of external mass-transfer effects, is best represented by two Arrhenius expressions, one applicable at low temperature and the other at high temperature. The two rate expressions appear to converge at about 1200°K, which is within the expected range for the freeboard temperature of AFBC's. The data indicate that the pilot plant elutriate char is less reactive at low temperature than the char produced directly from Kentucky No. 9. Different components of the elutriate char are also found to differ in reactivity at low temperatures. At high temperatures the elutriate and directly-made char appear to have essentially equal reactivity.

7212 (EPRI-CS—5501-Vol.1) **AFBC [atmospheric fluidized-bed combustion] conversion at Northern States Power Company: Volume 1, Project origins: Final report.** deBrun Duffy, J.; Hinrichsen, D. (Stone and Webster Engineering Corp., Boston, MA (USA)). Nov 1987. 90p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920075/JAW.

This is the first volume in a series of four reports detailing the conversion of Northern States Power Company's (NSP) Black Dog unit 2 from pulverized-coal firing to atmospheric fluidized-bed combustion (AFBC). This particular report describes the important events and decisions that led to NSP's selection of its Black Dog unit 2 for conversion to AFBC, and it provides an overview of AFBC technology and a discussion of the AFBC conversion market. The purpose of these reports is to disseminate the information gathered during the Black Dog AFBC Conversion Project to utilities evaluating the technical feasibility and cost effectiveness of converting units within their systems from pulverized-coal firing to AFBC. To this end, each volume in this series of reports presents material about a different aspect of the Black Dog project. Volume 2 - Unit Design describes the design of the new AFBC system and the important decisions that led to its final configuration; Volume 3 - Unit Demolition describes the major activities that occurred during the demolition and relocation phase; and Volume 4 - Unit Construction describes the major activities that occurred during the construction phase of the project. 17 refs., 9 figs., 12 tabs.

7213 (LMF—118) **Characterization and fate of vapor-phase organic constituents from atmospheric pressure fluidized bed combustors (AFBC): East Stroudsburg University AFBC.** Yeh, Hsu-Chi; Newton, G.J.; Henderson, T.R.; Hobbs, C.H. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). Aug 1987. Contract AC04-76EV01013. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001786/JAW.

Very little research has been devoted to the characterization of vapor-phase organic compounds in gaseous streams. Because of the concerns that gaseous organic compounds from FBCs may include potentially toxic and/or mutagenic materials. We will measure vapor-phase hydrocarbon concentrations in the process streams of operating FBCs. This report describes our field sampling results on the atmospheric pressure fluidized bed combustor (AFBC) at the East Stroudsburg University during its normal operation for supplying heat and hot water to the campus. This AFBC has a bed size of 36 $ft^2$ and was burning anthracite culm. The culm consumption rates during the week of our sampling period were 1600 to 3000 lb/hr. Emphasis was placed on characterization of process stream effluents, including particles and vapor-phase organic constituents. Results indicated that the mass concentration (or loading) of particulate matter within the effluent stream was similar to other FBCs that have been studied. The particulate mass concentration measured after the baghouse location was 0.0048 $g/m^3$ (0.0047 $lb/10^6$ Btu). This was equivalent to a total of 35 g/hr of particulate emissions. The fraction of particulate material presented as organics (extractable fraction) was, on the average, less than 2% of total mass of particulate emissions. The vapor-phase organic contents indicated that the quantities of individual polycyclic aromatic hydrocarbons (PAHs) were low, being less than 2.5 $\mu g/m^3$ for any individual sample. Most of the PAHs detected were low boiling compounds such as naphthalene or phenanthrene, with trace amounts of pyrene. 22 refs., 13 figs., 11 tabs.

7214 (PB—87-232138/XAB) **Technical guidance on the review and use of coal sampling and analysis (CSA) data.** Paley, L.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Oct 1985. 98p. (EPA—340/1-85/010). NTIS, PC A05/MF A01.

This document provides technical guidance to EPA's regional offices and State and local control agencies on the review and use of coal sampling and analysis (CSA) data in monitoring the compliance status of Subpart D boilers burning compliance coal and other large boilers which are not presently using $SO_2$ Continuous Emission Monitoring Systems (CEMS) nor submitting $SO_2$ Excess Emission Reports (EERs). The guidance is not applicable when the CSA method is specified as the emission compliance, alternative emission compliance, or sulfur-in-fuel compliance test method. The guideline describes specific forms and calculation methods to convert the source's coal sampling and analysis data into $SO_2$ EERs.

## 0160 Health And Safety

*REFER ALSO TO CITATION(S) 7206, 7214*

7215 **Comparative lung immunotoxicity of inhaled quartz and coal combustion fly ash.** Bice, D.E.; Hahn, F.F.; Benson, J.; Carpenter, R.L.; Hobbs, C.H. (Inhalation Toxicology Research Institute, Albuquerque NM (USA)). *Environmental Research;* **43**: No. 2, 374-389(Aug 1987).

This study evaluated the effects of inhaled insoluble fly ash particles or alpha quartz on the immune functions of lung-associated lymph nodes. F344 rats were exposed for 20 days by inhalation of fly ash from a fluidized bed combustor (FBC) or a pulverized coal combustor (PCC). Rats were similarly exposed to quartz particles (Min-U-Sil). Control rats were exposed to filtered air. Groups of ten exposed and ten control rats from each group were immunized by intratracheal instillation of $10^8$ sheep red blood cells at 4, 6, 40, and 52 weeks after the start of exposures. The cellularity of the lung-associated lymph nodes and antibody-mediated immunity were evaluated at 7 days after immunization. Tissues from lung and lung-associated lymph nodes were taken for histopathology. The inhalation of FBC fly ash, PCC fly ash, and quartz particles all significantly increased the number of lymphoid cells in the lung-associated lymph nodes at each of the sacrifice times. However, FBC fly ash had no significant effect on antibody immunity, while both PCC fly ash and quartz caused suppression of antibody responses at 52 weeks after the start of exposure. Histopathology data showed that exposure to quartz and PCC fly ash caused significant cellular changes in lungs and lung-associated lymph nodes, while FBC fly ash had less effect. These data indicate that an acute exposure (20 days) to relatively insoluble particles significantly increased the cellularity of the lung-associated lymph nodes for up to 52 weeks after the start of the exposure, but the pulmonary toxicity of the particles inhaled appeared to influence the effects of the exposure on antibody immune responses. 44 refs., 5 figs., 2 tabs.

### 0170 Legislation And Regulations

*REFER ALSO TO CITATION(S) 7559*

## 02 PETROLEUM

### 0202 Geology And Exploration

7216 **(PB—88-107560/XAB) Analysis of trace metals in bottom sediments in support of deep water biological processes studies on the US North Atlantic continental slope and rise. Final report, November 1984-September 1987.** Bothner, M.H.; Campbell, E.Y.; Parmenter, C.M.; Dangelo, W.; DiLisio, G.P. (Geological Survey, Woods Hole, MA (USA)). 30 Sep 1987. 105p. NTIS, PC A06/MF A01.

See also Interim report dated 24 Feb 1986, PB—86-191467.

The study is part of a multidisciplinary program conducted on the U.S. continental slope and rise off the North, Middle, and South Atlantic states to characterize the biology, chemistry, and geology of the sea floor in anticipation of exploratory drilling for petroleum resources. The distribution of sediment types and associated trace metals from natural sources will be used to help predict the fate and transport of sediment-reactive contaminants that may be introduced to the water column during future exploration and development activities. Sediment samples collected during the first three cruises to the continental slope and rise off the North Atlantic states were analyzed for 12 metals. The metal concentrations are lower than those reported for world average shales, indicating an absence of major contamination.

### 0203 Drilling And Production

7217 **Measurement and prediction of swelling factors and bubble points for paraffinic crude oils in the presence of CO/sub 2/ and contaminant gases.** Monger, T.G. (Dept. of Petroleum Engineering, Louisiana State Univ., Baton Rouge, LA 70803). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1147-1152(Jun 1987).

Effects on the phase equilibria and volumes of CO/sub 2// crude oil mixtures of adding N/sub 2/, CH/sub 4/, H/sub 2/S, or SO/sub 2/ contaminants are reported. Phase equilibria data were measured at temperatures above and below the CO/sub 2/ critical temperature and pressures up to 240 atm. Visual observations indicated conditions which promoted solid-phase formation. The data show that contaminant gases can have a pronounced effect on CO/sub 2/ solubility and oil swelling. These effects must be considered in CO/sub 2/ source selection and recycling for enhanced oil recovery.

7218 **Composition paths in four-component systems: The effect of dissolved methane on CO/sub 2/ flood performance in one dimension.** Monroe, W.W.; Silua, M.K.; Larsen, L.L.; Orr, F.M. Jr. (Stanford Univ.). pp 133-146 of Proceedings of the 1987 SPE annual technical conference and exhibition: Enhanced oil recovery. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16712.

New measurements of phase compositions and densities are reported for a quaternary system containing CO/sub 2/, methane, butane and decane at 106°F (71°C) and 1250 psia (8620 kPa) and for related ternary systems at the same conditions. Measured values of phase compositions and vapor densities agreed well with values calculated with the Peng-Robinson equation of state, though calculated liquid densities were somewhat less accurate. Composition paths for two-phase flow of four-component mixtures were calculated using the method of characteristics and the equation-of-state representation of the phase behavior. Analysis of resulting paths indicates why displacement efficiency in one-dimensional CO/sub 2/ floods is insensitive to the addition of dissolved methane to the oil displaced. Methane present in the oil partitions so strongly into the more mobile vapor phase that a methane-rich bank forms at the leading edge of the transition zone. The displacing CO/sub 2/ then encounters hydrocarbon mixtures containing no methane. The analysis indicates that high displacement efficiency is possible even when two-phase flow occurs throughout the displacement, and that high recovery is possible even when a live oil is displaced at a pressure below its bubble point pressure, if the pressure is above the minimum miscibility pressure for the same oil with all methane removed.

7219 **Prediction and interpretation of miscible displacement performance using a transverse matrix dispersion model.** Correa, A.C.; Pande, K.K.; Ramey, H.J. Jr.; Brigham, W.E. (Stanford Univ.). pp 31-44 of Proceedings of the 1987 SPE annual technical conference and exhibition: Enhanced oil recovery. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16704.

This paper considers interpretation of effluent flowing concentration data obtained from heterogeneous cores using the following heterogeneous models: Coats-Smith, porous sphere, and transverse matrix diffusion. Analytical solutions to the three heterogeneous models are presented in Laplace space. Approximate solutions for short and long time effluent flowing concentrations are developed from simplification of the Laplace transformation solution. These approximations are used to develop practical methods of interpretation of effluent concentration data to determine model parameters. Criteria for design of laboratory experiments are suggested based on these results. In this paper the solutions to the model equations are obtained by numerically inverting the Laplace transformed solutions using an efficient algorithm. This solution method is computationally advantageous to the conventional finite difference approximation. Results obtained from displacements in laboratory experiments only reflect the scales of heterogeneity present in the laboratory core. However, the scales of heterogeneity may be much larger in the reservoir. This paper discusses computation of miscible displacement performance based on a model which considers the interaction of heterogeneities present in the reservoir with mixing mechanisms.

### 0209 Environmental Aspects

*REFER ALSO TO CITATION(S) 7598, 7870*

### 0220 Transport, Pipelines, And Handling

7220 **(PB—88-102348/XAB) Assessment of DOD (Department of Defense) seaborne POL (petroleum, oil, and lubricants) distribution system. Final report, May 1986-July 1987.** Ireland, D.; Slemers, S.; McDermott, J.; Knapp, D.; Dahl, D. (Stanley Associates, Alexandria, VA (USA)). 14 Jul 1987. 112p. (TR—5-87). NTIS, PC A06/MF A01.

The report assesses the DOD seaborne petroleum-distribution system with three main objectives: (1) determine sufficiency of the U.S. flag and Effective U.S. Controlled (EUSC) tanker fleets to meet economic support and DOD needs; (2) evaluate port characteristics that may constrain tanker operations; and (3) determine tanker tank-cleaning capabilities for converting from dirty service to clean-product service. Particular emphasis was placed on the usefulness of tankers that are not normally used in refined-product distribution.

### 0230 Properties

*REFER ALSO TO CITATION(S) 7232*

### 0240 Storage

7221 **(PB—88-106752/XAB) Microbial problems when storing fuel oil in rock caverns. 2. Final report.** Roffey, R.; Edlund, A. (Foersvarets Forskningsanstalt, Umeaa (Sweden)). Jun 1987. 32p. (In Swedish). (FOA-C—40241-4.9). NTIS, PC E03/MF A01.

See also PB—85-104289.

During long-term storage of heavy fuel oil in rock caverns in Sweden, problems were encountered with microbial methane gas production. Chemical and microbial investigations were carried out at different storage plants, which made it possible to calculate a number of microbial processes. In a model system, different methods to inhibit the methane gas production in the bedwater was evaluated, e.g., oxygenation, increasing the pH to 9, use of biodegradable biocide, and addition of nitrate.

# 03 NATURAL GAS

## 0303 Drilling, Production, And Processing

**7222 (PB—88-101100/XAB) Field-data acquisition for tight-gas-sands research. Annual report, March 1986-February 1987.** Peterson, R.E. (CER Corp., Las Vegas, NV (USA)). Jul 1987. 68p. NTIS, PC A04/MF A01.

During the 12-month report period, CER Corporation continued to support GRI's Tight Gas Sands Program by performing work services in technical evaluations, field projects support, subcontract administration and technology transfer task areas. More specifically, these work services included: developing recommendations to GRI management on the current status of deep drilling research; monitoring drilling and completion activity in GRI's priority research areas; coordinated and supervised open-hole data-acquisition programs on co-op wells conducted with Arkla Exploration, Mobile Producing and Phillips Petroleum; administered subcontracts with Teledyne Geotech, Resources Engineering Systems, Applied Geomechanics, Inc., Lewin and Associates, NIPER and others that resulted in data products work services acquired for tight gas sands research; and compiled and distributed two issues of In Focus - Tight Gas Sands. These services and others, performed in the March 1986 to February 1987 report period, are described in the report along with major results of the work.

**7223 (PB—88-107982/XAB) Natural gas supply subprogram status report, 1986.** (Gas Research Inst., Chicago, IL (USA)). Dec 1986. 134p. (GRI—87/0134). NTIS, PC A07/MF A01.

This 1986 status report presents tactical objectives, goals, accomplishments, strategies, and contract status of ongoing projects in GRI's Natural Gas Supply R & D Subprogram that mainly address unconventional supply sources which cannot be economically exploited using existing recovery and stimulation techniques. Fifteen projects in the Tight Gas Sands area will develop the information, tools, and diagnostic capability to increase the recovery effectiveness and reduce the production costs of natural gas from tight-gas-sands reservoirs. In the Eastern Devonian Gas Shales area, 15 projects seek to develop an effective exploration rationale, understand production controls, and develop stimulation techniques. In the Co-Production of Gas and Water Area, exploitation of abandoned water-drive reservoirs is supported by six projects that will develop reservoir models, completion and production strategies, and brine management and control techniques. Eight projects in the Methane From Coal Deposits Area will provide the reservoir understanding, models, techniques, and tools for cost-effective recovery of methane from unminable coal deposits. In the Exploration and Production Technology area, three projects aim to reduce the cost of natural gas from both conventional and unconventional sources.

## 0305 Health And Safety

**7224 (NVO—319) Report of the Investigation Board for the unplanned fire at the Liquefied Gaseous Fuels Spill Test Facility on August 29, 1987.** (USDOE Nevada Operations Office, Las Vegas). 23 Oct 1987. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002214/JAW.

This report describes the investigation of a flash fire that occurred during spill tests of liquified natural gas. The explosive force of the fire significantly damaged test facilities and equipment, but the sequence of events was well documented by several possible causes were investigated. 10 figs., 2 tabs. (TEM)

## 0306 Marketing And Economics

*REFER ALSO TO CITATION(S) 7577, 7580*

**7225 (DOE/EIA—0130(87/08)) Natural gas monthly, August 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 30 Oct 1987. 130p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88002626/JAW.

This report highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer related activities and underground storage data are also reported. The data in this publication are collected on surveys conducted by the Energy Information Administration (EIA), of the Department of Energy (DOE), to fulfill its responsibilities for gathering and reporting energy data. Some of the data are collected under the authority of the Federal Energy Regulatory Commission (FERC), an independent commission within the DOE, which has jurisdiction primarily in the regulation of electric utilities and the interstate natural gas industry.

**7226 (DOE/EIA—0131(86)/1) Natural gas annual 1986: Volume 1.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 30 Oct 1987. 284p. NTIS, PC A13 - GPO. Order Number DE88002586/JAW.

This report provides information on the supply and disposition of natural gas to a wide audience including industry, consumers, federal and state agencies, and educational institutions. The data are presented in a sequence that follows natural gas (including supplemental supplies) from its production to its end use. Annual summary data on the quantity and average price of natural gas production at the state and national levels are given, as well as total gas supply/disposition balances. Data on the quantity and price of natural gas consumption are shown for major end-use categories by state. Historical data are then shown in the same sequence.

**7227 (PB—88-107974/XAB) Industrial gas use: targets of opportunity.** (Gas Research Inst., Chicago, IL (USA)). 1987. 10p. (GRI—85/0030.1). NTIS, PC A02/MF A01.

Color illustrations reproduced in black and white.

This summary is based on a report, Analysis of Relative Industrial Performance and Its Implications for Gas Demand, that analyses the outlook for major gas-using industries and the potential opportunities for enhanced gas technologies to benefit industrial gas users and consumers. Although important structural changes in the manufacturing sector have greatly reduced the relative growth of output and investment of many major gas users, 20 industries have been identified as having the best growth prospects and potential for investing in new gas-using technologies. These include plastic materials and resins, aluminum rolling and drawing, motor vehicle parts, glass products, organic chemicals, paper and paperboard mills, steel mills, the drug industry, nonferrous metals, fabricated metals, equipment producers, and mineral wool.

**7228 (PB—88-113055/XAB) Analysis of the outlook for natural gas and energy in eight industries.** (Data Resources, Inc., Lexington, MA (USA)). May 1986. 288p. NTIS, PC A13/MF A01.

The second phase of a two-phase study to gain perspective into the ongoing restructuring of the U.S. manufacturing sector and its impact on gas demand focuses on eight industries and their potential for increased gas consumption: secondary nonferrous metals, plastic materials and resins, miscellaneous plastic products, synthetic organic chemicals, paper and paperboard, pharmaceuticals, nonferrous rolling and drawing, and motor vehicle parts and accessories. The analysis covers the period 1982-1990, evaluates energy/economic trends within the sector; projects demand for gas, oil, coal, and electricity by sector; evaluates fuel substitution possibilities from the engineering and economic (based on price elasticities) perspectives; links an industry's investment pattern and growth in energy demand, and illustrates for each industry those situations where other fuels may have a competitive advantage.

## 0309 Artificial Stimulation

*REFER ALSO TO CITATION(S) 7223*

7229 **(PB—87-231858/XAB) Effects of stimulation treatments on coalbeds and surrounding strata: evidence from underground observations. Report of Investigations/1987.** Diamond, W.P.; Oyler, D.C. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 55p. (BM-RI—9083). NTIS, PC A04/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 86-607907.

Stimulated vertical boreholes are an effective means of removing gas from coalbeds in advance of mining. The Bureau of Mines report examines the coal-mine roof-damage potential of stimulation treatments. Twenty-two Government-sponsored stimulation treatments have been mined through to determine the effects on the coalbed and roof strata. Vertical fractures in the coalbed were discernible for most treatments, and horizontal fractures were present for about half of the stimulations. Sand-propped vertical fractures were usually short in lateral extent. Evidence of stimulation-fluid movement could generally be traced beyond the maximum extent of sand-filled fractures when fluorescent paint was added to the treatment fluids. The maximum lateral extent for a sand-filled vertical fracture was 416 ft, and a paint-coated vertical fracture extended 630 ft. No roof falls or adverse mining conditions were encountered that could be attributed to the stimulations.

7230 **(PB—87-232104/XAB) Coalbed methane development in Alabama: biotoxicity of produced water originating from coalbed-degasification wells in the Cedar Cove field, a proposed study plan. Topical report, June 1986-June 1987.** O'Neil, P.E.; Hamaker, T.; Fillo, J.P. (Alabama Geological Survey, University (USA)). Jun 1987. 43p. NTIS, PC A03/MF A01.

The study plan outlines work elements and methodology for conducting both field experiments and aquatic toxicity testing using a natural-gas-produced water disposed via stream discharge. The goal of the study is to examine relationships between laboratory toxicity testing and actual instream exposure experiments and develop a procedure for analyzing environmental effects from and control options for discharge of produced waters. Produced waters originating from coalbed methane development were selected for examination because of their relatively low dissolved solids content and the permitted disposal practices of stream discharge and land application.

7231 **(PB—88-104625/XAB) Coordination of geological and engineering research in support of the Gulf Coast co-production program. Annual report, June 1986-May 1987.** Tyler, N.; Light, M.P.R.; Ambrose, W.A. (Texas Univ., Austin (USA). Bureau of Economic Geology). 31 Aug 1987. 213p. NTIS, PC A10/MF A01.

See also report for Aug 1985-May 1986, PB—87-101028.

Complex and heterogenous Hackberry reservoirs at Port Arthur field were deposited in a submarine canyon/fan setting. Conventional fieldwide hydrocarbon recovery efficiencies are low, but the potential for secondary gas recovery is high. Free gas remains trapped in uncontacted and untapped compartments at reservoir abandonment. The total fieldwide resource amounts to 13.9 Bcf. The probable and possible resource for a single infill well is 6.5 Bcf in four separate stringers. Three optimum brine-disposal sands and the best brine-disposal site were selected in Northeast Hitchcock field on the basis of sand-body complexity, thickness, depth, and brine-disposal capacity. The equilibrium distribution of inorganic species in different combinations in the produced waters at surface and formation temperatures and pH were estimated from chemical analyses. SOLMNEQ computations suggest carbonate scaling may occur in surface equipment of Miocene disposal sandstones unless inhibitors are used. At Northeast Hitchcock field, well-winnowed sandstones of shallow-marine origin compose the major reservoir sands and act as preferential conduits for fluid migration. Dislodged, abundant authigenic kaolinite in these sands can plug pores during production, suggesting a maximum rate of production will need to be determined to avoid reservoir damage.

## 0320 Transport, Pipelines, And Handling

*REFER ALSO TO CITATION(S) 7224*

## 0330 Properties

7232 **(PB—87-232211/XAB) Analyses of natural gases, 1917-85. Information Circular/1987.** Moore, B.J.; Sigler, S. (Bureau of Mines, Amarillo, TX (USA). Helium Field Operations). 1987. 1205p. (BM-IC—9129). NTIS, PC A99/MF E06.

Also available from Supt. of Docs. For system on magnetic tape see PB—86-224607; Library of Congress catalog card No. 86-607917.

This publication contains 14,242 analyses of gas samples from oil and gas wells and natural gas pipelines in 40 States and 24 foreign countries. These gas samples were collected during the period 1917-85 as part of the Bureau of Mines survey for helium occurrences. The gas analyses contained herein were made by several methods over the period covered. Analytical work on samples collected early in the period was done on the Orsat apparatus. The one-cut apparatus and four-cut fractional distillation equipment were added later. A mass spectrometer was acquired in 1949 and used for all gas analyses made after that time. From 1917 to 1978, helium analyses were made on special helium analytical equipment designed and built by the Bureau of Mines Helium Operations Laboratory. In 1978, the apparatus was replaced in the quantitative helium analysis work by a gas chromatograph.

## 0340 Combustion

*REFER ALSO TO CITATION(S) 7837, 7838*

7233 **(PB—88-112750/XAB) Investigation of NOx formation and removal mechanisms in hydrocarbon-air flames. Annual report, July 1986-June 1987.** Hanson, R.K.; Bowman, C.T. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Jun 1987. 29p. NTIS, PC A03/MF A01.

The first year of a three-year experimental and analytical effort to determine the mechanisms of NOx formation and removal in natural gas flames resulted in a detailed kinetics model including nitrogen chemistry to calculate nitric oxide production via two reaction paths: direct oxidation of molecular nitrogen by atomic oxygen in high temperature air and reaction of hydrocarbon radicals with molecular nitrogen to form compounds leading to nitric oxide. Kinetics calculations to assess the relative importance of the thermal and prompt NO mechanisms to total NOx formation for methane-air combustion, and flame experiments utilizing a flat flame burner and a shock tube confirmed (1) dominance of the thermal NO mechanism at high temperatures and (2) validity of the Zeldovich reactions in predicting NO emissions by this mechanism. However, significant gaps remain in the understanding of NO kinetics in lower flame temperatures where the prompt NO mechanism predominates. Work is continuing on the development of laser-photolysis schemes for the production and sensitive detection of hydrocarbon radical species.

# 04 OIL SHALES AND TAR SANDS

## 0402 Site Geology And Hydrology

7234 **(DOE/ET/13097—2003) Mineralogy and geochemistry of the Green River Formation, Colorado Core Hole No. 1, Piceance Creek Basin, Colorado: Final report.** Slaughter, M.; Mathews, A. (Colorado School of Mines, Golden (USA)). Mar 1984. Contract AS20-78ET13097. 904p. NTIS, PC A99/MF A01; Does not include Appendix I which consists of 354 photos available from OSTI; GPO Dep. Order Number DE86001065/JAW.

Selected samples of the Green River Formation, Colorado Core Hole No. 1, were analyzed to aid characterization and under-

standing of the genesis of the oil shales of the Piceance Creek Basin, Colorado. About 120, 2-4 inch samples from the Parachute Creek and Garden Gulch Members were analyzed for 18 major and minor elements, 12 selected race elements and quantitative mineral content. About 70 samples were scanned, perpendicular to the bedding, by electron microprobe to determine semiquantitative elemental microstratigraphy of nine selected elements. This report describes the analytical procedures, presents the results, includes photos, and interprets the depositional geochemistry which produced the analyzed rocks. The seven appendices include; (1) descriptions and photographs of samples; (2) chemical and mineral analyses; (3) electron microprobe analyses; (4) down-section elemental distribution; (5) down-section mineral distribution; (6) down-section mineral content; and (7) organic content. 38 refs.

# 05 NUCLEAR FUELS

## 0504 Feed Processing

7235 **(UJV—7857-M) Studies in solid state ionics.** Jakes, D.; Rosenkranz, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). Jan 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700830/JAW.

Studies performed over 10 years by the high temperature chemistry group are reviewed. Attention was paid to different aspects of ionic solids from the point of view of practical as well as theoretical needs of nuclear technology. Thus ceramic fuel compound like uranates, urania-thoria system, solid electrolytes based on oxides and ionics transformations were studied under reactor irradiation. (author) 13 figs., 3 tabs., 46 refs.

## 0505 Uranium Enrichment

*REFER ALSO TO CITATION(S) 7265*

7236 **(UCRL—15962) Thermal analysis for CVL's: Part 2, Final report.** (Science Applications International Corp., McLean, VA (USA). Plasma Physics Div.). 1 Jun 1987. Contract W-7405-ENG-48. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002469/JAW.

This report documents work carried out for the Copper Vapor Laser (CVL) technology group in the Atomic Vapor Laser Isotope Separation (AVLIS) program at LLNL. The problems addressed in this subcontract have focused on the efficient calculation of thermal viewfactors in three-dimensional configurations. Part I of this report provides a detailed description of the algorithms employed in the VuSymP code which has been developed under this subcontract, and has been delivered to LLNL. This volume describes several enhancements of VuSymP which have been implemented to make the code more useful to the CVL group at LLNL.

## 0507 Fuels Production And Properties

*REFER ALSO TO CITATION(S) 7246*

## 0508 Spent Fuels Reprocessing

7237 **A simplified process for the extractive distillation of nitric acid.** Jubin, R.T.; Counce, R.M.; Holland, W.D.; Groenier, W.S.; North, E.D. (Oak Ridge National Lab., P.O. Box X, Building 7601, Mail Stop 306, Oak Ridge, TN 37831). *Industrial and Engineering Chemistry Research;* **26**: No. 5, 990-996(May 1987). Contract AC05-84OR21400.

A simple process for the concentration of aqueous nitric acid has been demonstrated in pilot plant operation as part of the Consolidated Fuel Reprocessing Program at the Oak Ridge National Laboratory. A mathematical model of this process shows reasonable agreement with important experimental data. This extractive distillation process utilizes an aqueous solution of magnesium nitrate as the solvent and is a simplified version of that used commercially. The process features two vessels for the distillation and solvent recovery operations. The acid feed and product compositions and flow rates were determined with reasonable certainty.

## 0509 Transport And Storage

7238 **(CEPN—106) Optimization of public protection in the case of transportation of radioactive materials.** Pages, P.; Hubert, P. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751368/JAW.

The initial purpose of the study was to assess risk to the public associated with UF/sub 6/ transportation in France as projected for the years to come. In a first stage a particular risk assessment methodology has been developed at the CEPN in the field of radioactive material transportation, through this first example and some others. Then a number of questions were raised as to the opportunity of given safety measures, associated for example with possible changes in the regulations. One such measure could be to adopt an overpack for natural uranium hexafluoride containers. This particular action and others bearing on either natural or enriched uranium hexafluoride transportation in both truck and rail modes were envisaged. The case study presented here deals with the comparison of a set of such alternative options aiming at reducing the risk to the public in the transportation of natural UF/sub 6/ by truck in France. Risk from the transportation only itself is taken into account, risk is assessed for accident situations only, health detriment is evaluated only for the consequences of the release itself.

7239 **(CEPN—112) Multicriteria analysis of protection actions in the case of transportation of radioactive materials: Regulating the transit of type A packages through the Mont Blanc Tunnel.** Hubert, P.; Lombard, J.; Pages, P. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751370/JAW.

The utility function approach (decision analysis) is one of the classical decision aiding techniques that are of interest when performing ALARA analysis. In this paper a case study will serve as an illustration of this technique. The problem which is dealt with is the set up of a regulation applying to the transit of small radioactive material packages (type A) under the Mont Blanc Tunnel which is a major route between France and Italy. This case study is therefore a good example of an ALARA approach applied to a safety problem which implies both a probabilistic risk assessment and the evaluation of very heterogeneous criteria.

7240 **(PNL—6206-Vol.3) HYDRA-II: A hydrothermal analysis computer code: Volume 3, Verification/validation assessments.** McCann, R.A.; Lowery, P.S. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 203p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88003443/JAW.

HYDRA-II is a hydrothermal computer code capable of three-dimensional analysis of coupled conduction, convection, and thermal radiation problems. This code is especially appropriate for simulating the steady-state performance of spent fuel storage systems. The code has been evaluated for this application for the US Department of Energy's Commercial Spent Fuel Management Program. HYDRA-II provides a finite difference solution in cartesian coordinates to the equations governing the conservation of mass, momentum, and energy. A cylindrical coordinate system may also be used to enclose the cartesian coordinate system. This exterior coordinate system is useful for modeling cylindrical cask bodies. The difference equations for conservation of momentum are enhanced by the incorporation of directional porosities and permeabilities that aid in modeling solid structures whose dimensions may be smaller than the computational mesh. The equation for conservation of energy permits modeling of orthotropic physical properties and film resistances. Several automated procedures are available to model radiation transfer within enclosures and from fuel rod to fuel rod. The documentation of HYDRA-II is presented in three separate volumes. Volume I - Equations and Numerics describes the basic differential equations, illustrates how the difference equations

are formulated, and gives the solution procedures employed. Volume II - User's Manual contains code flow charts, discusses the code structure, provides detailed instructions for preparing an input file, and illustrates the operation of the code by means of a model problem. This volume, Volume III - Verification/Validation Assessments, provides a comparison between the analytical solution and the numerical simulation for problems with a known solution. This volume also documents comparisons between the results of simulations of single- and multiassembly storage systems and actual experimental data. 11 refs., 55 figs., 13 tabs.

## 0520 Waste Management

*REFER ALSO TO CITATION(S) 7146, 7466, 7472, 7473, 7475, 7476, 7499, 7510, 7642, 7874, 7880*

7241 **(BMI—1985-088) Radioactive waste containment - a literature study. Final report.** Mohiuddin, G. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Oct 1985. 110p. (In German). (GRS-A—1096). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751264/JAW.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

One of the basic requirements of safe radioactive waste disposal is isolation of the radioactive substances to prevent leakage into the biosphere. The multi-barrier concept has been developed to meet this requirement. Within the framework of the concept, barriers can be either natural or man-made. Natural barriers, i.e. geologic formations,have been investigated for their suitability, with host rock and their different properties being determined and compared. It has been found that the qualification of a proposed repository medium cannot be defined on the basis of physical, chemical, and mineralogical criteria alone, but that these data have to be completed by a global evaluation of the entire system consisting of waste products and waste forms, host rock, and surrounding rock. The study in hand reviews the reports and also lists the studies made on engineered barriers, as e.g. immobilisation barriers, container and package barriers, of various waste forms. A review of the studies dealing with the various waste disposal techniques shows that the sub-surface waste disposal and the deep underground disposal in mines are the best developed techniques currently. A review of ultimate disposal concepts adopted abroad shows that most countries favour the mining technology approach, with the exception of Denmark where R and D work in this field is focused on deep well disposal.

7242 (CONF-871018—Vol.1, pp I.1-I.15) **International co-operation on decommissioning within the OECD/NEA.** Bertini, A.; Menon, S. 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The OECD/NEA Co-operative Programme on Decommissioning was established to share the technologies and know-how resulting from a number of major decommissioning projects. It started in 1985 with nine participating countries and ten on-going projects. Since then, the Co-operative Programme has been expanded to cover twelve decommissioning projects. An overview of the projects in the Programme and a critical appraisal of the development and the benefits resulting from it are given.

7243 (CONF-871018—Vol.1, pp I.16-I.29) **IAEA activities in decommissioning and decontamination.** Feraday, M.A. (International Atomic Energy Agency, Vienna, Austria). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

To assist Member States in the development and implementation of the required decommissioning expertise, the IAEA is developing an integrated data base covering in a systematic way, the wide range of technical regulatory and safety aspects associated with the decommissioning and decontamination (D/D) of all types of nuclear facilities, sites and large contaminated areas. The program also includes the maintenance and refurbishment of nuclear facilities and the rehabilitation and closeout of uranium mill tailings impoundment facilities. To fulfill its functions, the Agency collects and disseminates up-to-date information on D/D, supports research and provides technical assistance to Member States.

7244 (CONF-871018—Vol.1, pp I.30-I.34) **Advances in the European Community's programme of research on decommissioning.** Huber, B. (Commission of the European Communities, Brussels, Belgium). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Commission of the European Communities continues implementing a program of research on the decommissioning of nuclear installations. The program includes the development and testing in practice of advanced techniques for decommissioning activities such as decontamination and dismantling of redundant installations, and management of the radioactive waste arising therefrom. Among the advances achieved recently, the industrial-scale demonstrations of new procedures for decontamination and recycling of steel are of particular importance, since these procedures make it possible to substantially reduce the radioactive waste volume.

7245 (CONF-871018—Vol.1, pp II.132-II.144) **Working with the public.** Dubois, D.; Scotti, K. (Jacobs Engineering Group Inc., Albuquerque, NM). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The public and community relations programs associated with the US Department of Energy Uranium Mill Tailings Remedial Action Project processing sites and vicinity properties are discussed. Emphasis is placed on the importance of early establishment of clear-cut public relations policies, early dissemination of information, and use of public relations professional to monitor and coordinate public response to cleanup activities. Case studies of three processing site and vicinity property communities are presented.

7246 (CONF-871018—Vol.1, pp III.50-III.54) **Fuel fabrication facility decommissioning experience.** Adkisson, R.J. (Sequoyah Fuels Corp., Oklahoma City, OK). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

For the past several years, Sequoyah Fuels Corporation has been decommissioning its Cimarron Facility located in north central Oklahoma. The facility contained separate plutonium and enriched uranium fuel fabrication plants. The site also contained small settling lagoons and a small shallow burial area used to dispose of uranium - and thorium-contaminated wastes. The objective of the decommissioning activity is to decontaminate the facilities for termination of the Nuclear Regulatory Commission licenses, with no restrictions on future use of the property. The decommissioning work involved: decontamination of the plutonium fuel fabrication plant; decontamination of the enriched uranium fuel fabrication plant; excavation, packaging and shipment of the lagoon sediments and associated underground piping; and excavation, repackaging and shipment of the low-level radioactive wastes in the burial ground. These activities are discussed.

7247 (CONF-871018—Vol.1, pp III.55-III.67) **Decommissioning experience of the reprocessing facility AT 1.** Montjoie, M.; Lurie, R.; Roger, J. 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

AT1 was a pilot plant for reprocessing the mixed oxide fuel elements from the FBR program. It was operated successfully during ten years and definitively shut down in 1979. After two years of fissile material recovery and decontamination of the process line it was decided to decommission the unit to stage 3. Even though small in reprocessing capacity, it contained all the difficulties and specific problems of this type of facility, and needed the development of equipment such as: a remote controlled machine for dismantling the main cells; a modular $\alpha$ tight workshop to dismantle the glove boxes and $\alpha$ cells; and an $\alpha$ activity measurement sta-

tion to be able to fit with the requirements of the disposal site. These activities are discussed.

7248 (CONF-871018—Vol.1, pp III.68-III.76) **Decommissioning of International Nutronics Cobalt-60 Irradiation Facility.** Thomas, B.J. (Irradiation Consulting Services, Somerville, NJ). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Decommissioning for International Nutronics Cobalt-60 Irradiation Facility located at Dover, New Jersey was completed in 1986 and unrestricted radiological release was obtained under the regulatory purview of the US Nuclear Regulatory Commission Region I. The Final Radiological Release Report for the International Nutronics Facility, Dover, New Jersey was submitted to and approved by the Nuclear Regulatory Commission to verify the completion of programs to achieve unconditional radiological release of the facility and environs. The Decommissioning Project was an extensive series of programs which utilized technologies for the disposition of kilocurie sources of encapsulated Cobalt-60 Sources as well as low-level environmental contamination evaluation and decontamination procedures.

7249 (CONF-871018—Vol.1, pp III.148-III.159) **Los Alamos Transuranic Waste Size Reduction Facility.** Harper, J.; Warren, J. (Los Alamos National Lab., NM). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Los Alamos Transuranic (TRU) Waste Size Reduction Facility (SRF) is a production oriented prototype completed in 1981 and later modified during 1986 to enhance production. The facility is operated to remotely cut (with a plasma arc torch) and repackage TRU contaminated metallic wastes (e.g., glove boxes, ducting and pipes) for eventual disposal at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The resulting flat sections are packaged into a tested Department of Transportation Type 7A metal container. To date, the facility has successfully processed stainless steel glove boxes (with and without lead shielding construction) and retention tanks. It was found that used glove boxes generate more cutting fumes than do unused glove boxes or metal plates - possibly due to deeply embedded chemical residues from years of service. Water used as a secondary fluid with the plasma arc cutting system significantly reduces visible fume generation during the cutting of used glove boxes and lead-lined glove boxes.

7250 (CONF-871018—Vol.1, pp III.176-III.188) **Decontamination and decommissioning of depleted uranium manufacturing facility.** Bernhardt, D.E.; Prewett, S.V.; Pittman, J.D.; Owen, D.H.; Douglas, R.D. (Rogers and Associates Engineering Corp., Salt Lake City, UT). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Aerojet Ordinance Tennessee, Inc. (Aerojet) is decommissioning its Compton, California, depleted uranium (DU) manufacturing facility. Aerojet has conducted manufacturing and research and development activities at the facility since 1977 under a State of California Source Materials License. The decontamination and certification of cleanup is being managed by an independent company, Rogers and Associates Engineering Corporation, and the removal of government facilities and decontamination of the facility is being performed by a contractor. The facility will be released for uncontrolled use and is being decontaminated in accordance with US Nuclear Regulatory Commission Guide 1.86. It will be decontaminated to levels as low as reasonably achievable (ALARA). The removal of government facilities/equipment was performed in early 1987. The decontamination of the facility was started in May 1987, and is scheduled for completed in August 1987.

7251 (CONF-871018—Vol.1, pp III.189-III.200) **Closure for depleted uranium thorium waste pond.** Bernhardt, D.E.; Prewett, S.V.; Douglas, R.D. (Rogers and Associates Engineering Corp., Salt Lake City, UT). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Aerojet Ordinance Tennessee Inc. (AOT), completed the closure of an inactive waste evaporation pond at its Jonesboro, Tennessee, facility in September 1985. The final closure activities of the comprehensive action program for decommissioning the process waste pond, excavation of associated contaminated soils, and on-site disposal of the contaminated soil are described. Rogers and Associates (RAE) developed remedial action guides for the project and the final designs, and managed the remedial action with the assistance of Dames and Moore. The project represents one of the first actions of this type by a private company. The closure program was performed under licensing by the State of Tennessee.

7252 (CONF-871018—Vol.1, pp III.210-III.218) **Decontamination and decommissioning of building 41.** Rader, P.L.; Creech, P.W.; Michigan, R.J. (Monsanto Research Corp., Miamisburg, OH). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Building 41 was a one story, above-ground 36′ x 9′ x 9′ concrete block structure with a fifteen (15) foot poured concrete basement that contained two (2) 3500 gallon tanks and pumping system. A pole barn structure was erected over Building 41 to contain contamination during removal. Steel sheet piling and oak shoring eliminated cave in dangers. Removal was accomplished with a remote excavator (Mini-Max), trackhoe and concrete bucket. Final excavation, sampling and surveying are in process. Upon final release, the excavation will be sealed, filled and the site restored.

7253 (CONF-871018—Vol.1, pp III.219-III.236) **Decontamination and decommissioning of the MTR-603 HB-2 cubicle.** Smith, D.L. (EG & G Idaho, Inc., Idaho Falls). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The decontamination and decommissioning (D & D) of the MTR-603 HB-2 cubicle located at the Idaho National Engineering Laboratory (INEL) are described. The HP-2 cubicle became radioactively contaminated during out-of-pile circulating water loop experiments conducted in the Materials Testing Reactor in the 1950s and 1960s. The work performed to accomplish the D & D objectives of reducing the high radiation fields caused by contamination inside the cubicle, preventing future contamination spread, and making about 1400 $ft^2$ of floor space available for reuse are discussed. Decommissioning of the HB-2 cubicle consisted of total dismantlement of the cubicle and its contents and was performed without disrupting ongoing laboratory work being conducted in areas surrounding the HB-2 cubicle.

7254 (CONF-871018—Vol.1, pp III.237-III.253) **Decontamination and decommissioning of the Initial Engine Test Facility.** Stoll, F.E.; Bohrer, H.A.; Voldness, C.M. (Idaho National Engineering Lab., Idaho Falls). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Initial Engine Test (IET) facility was constructed and operated at the National Reactor Testing Station, now known as the Idaho National Engineering Laboratory (INEL), to support the Aircraft Nuclear Propulsion Program and the Systems for Nuclear Auxiliary Power Transient test program, circa 1950 through the 1960s. Due to the severe nature of these nuclear test programs, a significant amount of radioactive contamination was deposited in various portions of the IET facility. Characterizations, decision analyses, and plans for decontamination and decommissioning were prepared from 1982 through 1985. Decontamination and decommissioning activities were performed in such a way that no radiological health or safety hazard to the public or to personnel at the INEL remains. These decontamination and decommissioning activities began in 1985 and were completed in 1987.

7255 (CONF-871018—Vol.1, pp III.254-III.268) **Decommissioning of redundant radioactive working area at HM Dockyard, Chatham, Kent.** Warren, G.A. (Rolls-Royce and Associates Ltd., Derby, England). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Royal Navy Dockyard was closed in 1981, including the Nuclear Submarine Refitting facility. Decommissioning of the radioactive facilities was scheduled to take place in 1985 and the methods of planning, estimating and executing the work are described. A full review and analysis of the problem was carried out, showing that a variety of buildings, plant and equipment were radioactively contaminated with $\beta$-$\gamma$ emitters. A timescale of 12 months for full decommissioning was estimated and, with the degree of contamination expected, a cumulative dose burden of 66 mSv was expected. Cost was estimated at 1.0M pounds. Although the task was recognized as of relatively minor radiological significance, estimated activity 200 - 250 GBq, methods of work control would be identical to any adopted for more heavily contaminated facilities. The decommissioning site included workshops, laboratories, offices and outdoor facilities comprising pipework, trenches, ductwork and ventilation equipment. In the workshop areas were heavy machine tools, refuelling equipment and miscellaneous minor equipments. The decommissioning operation was judged to be successful, allowing the owner to enter the complex free from restrictions to carry out the necessary follow-on work for the site. Cumulative dose burden was close to the estimated and the task was completed to financial budget in approximately the predicted timescale.

7256 (CONF-871018—Vol.1, pp III.269-III.280) **Managing the present and future costs of decommissioning.** Azorsky, T.L.; Fenster, H.L. 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The lack of state and federal standards for decommissioning and decontamination (D & D) of nuclear facilities may result in additional costs years after the D & D is complete. Increased costs may result from the application of certain environmental statutes to the facility or from personal injury and property damage, i.e., tort, litigation. Companies that operated facilities that provided a service or product for the government have certain financial protections and certain immunities from suit. Companies operating commercial facilities, however, have little or no protection from future liabilities. Accordingly, this country needs federal standards for D & D, standards that would govern the level of decontamination required and protect companies completing the D & D effort from future liability.

7257 (CONF-871018—Vol.1, pp III.281-III.292) **Decommissioning: an insurance perspective.** Fuller, P.E. (American Nuclear Insurance, Farmington, CT). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The nuclear insurance pools, through American Nuclear Insurers (ANI) and the Mutual Atomic Energy Liability Underwriters (MAELU), have been providing third-party nuclear liability insurance to the nuclear industry since 1957. Third-party liability and property damage coverage resulting from the nuclear hazard are provided by separate insurance policies issued by the nuclear insurance pools. A liability insurer's view of decommissioning is addressed by discussing the following: insurer's perspective of potential nuclear liability; insurance claim experience and trends; objectives and accomplishments of ANI/MAELU's involvement with facility decommissioning; and important nuclear liability considerations for facility decommissioning.

7258 (CONF-871018—Vol.1, pp III.324-III.331) **Radiological assurance on decommissioning projects.** Whittaker, M.S. (Chem-Nuclear Systems, Inc., Columbia, SC). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Decommissioning projects present unique challenges to radiological safety staffs due to changing conditions as the project progresses as well as the differences from one project to another. These challenges are increased for companies, like Chem-Nuclear Systems, Inc., that perform several projects simultaneously and that employ a variety of subcontractors for various aspects of the project, often utilizing local unskilled labor. Lessons learned in the development of Quality Assurance programs can be applied to the problem of maintaining radiological safety on diverse projects. The Radiological Assurance program, currently in place at Chem-Nuclear to assure that corporate safety policy and goals are being met on decommissioning projects at multiple and temporary job sites is described.

7259 (CONF-871018—Vol.2, pp IV.8-IV.22) **Decontamination and decommissioning of the chemical process cell (CPC) at the West Valley Reprocessing Facility.** Lawrence, R.E.; Meigs, R.A. 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

To support interim storage of vitrified high level waste at the West Valley Demonstration project, the shielded, remotely operated Chemical Process Cell (CPC) was decommissioned and decontaminated. All equipment was removed, packaged and stored for future size reduction and decontamination. Floor debris was sampled, characterized, and vacuumed into remotely handled containers. The cell walls, ceiling, and floor were decontaminated. Three 20 Mg (22.5) ton concrete neutron absorber cores were cut with a high pressure water/abrasive jet cutting system and packaged for disposal. All operations were performed remotely using two overhead bridge cranes which included two 1.8 Mg (2-ton) hoists, one 14.5 Mg (16-ton) hoist, and an electro-mechanical manipulator. Additional operations were performed by an industrial robot mounted on a mobile platform. Initial general area dose rates in the cell ranged from 1 to 50 R/hr and were reduced significantly. Target levels of less than 10 mR/hr general area readings were established before decontamination and decommissioning was initiated. The specific results obtained are summarized.

7260 (CONF-871018—Vol.2, pp IV.23-IV.30) **Use of foam chemicals for decontamination.** Meigs, R.A. 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A means of rapid, gross smearable contamination removal is being used at the West Valley Demonstration Project. Decontamination chemicals are made into a foam using foam stabilizing surfactants and blown with compressed air onto surfaces to be decontaminated. The foam is left to work for 15 to 30 min. and is rinsed with 3500 to 7000 KPa (500 to 1000 psi) water sprays. Spent decontamination solution generated ranges from 0.03 $1/M^2$ to 0.14 $1/M^2$ (0.08 to 0.40 gal/sq. ft.). Decontamination factors for smearable contamination up to 10 are routinely achieved.

7261 (CONF-871018—Vol.2, pp IV.31-IV.43) **Remote cutting and removal of chemical processing cell's concrete pedestal bases.** Vandervort, R.E.; Wiedemann, L.W. 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

As part of the decommissioning of the Chemical Process Cell (CPC) at the West Valley Demonstration Project (WVDP), three 2.24 m (7 ft -4 in) diameter blocks of steel reinforced concrete had to be removed from the floor of the CPC. These blocks, which were cast into the CPC floor and covered with stainless steep as part of the floor liner, had to be cut free from the floor prior to removal in one piece. Tooling was developed to remotely cut the pedestal within 13 mm (1/2 in) of the floor with a 240 M Pa (35,000 psi) abrasive water-jet cutting system. Two of the pedestals weighed 20 Mg (22 1/2 tons) each with only a 14.5 Mg (16-ton) overhead hoist available for handling. Special fixtures were developed which allowed the pedestals to be tipped over onto a transfer car. The transfer car was also a WVNS design, specifically built for

pedestal removal. The pedestals were ultimately transferred into an outer room for placement in metal boxes for disposal.

7262 (CONF-871018—Vol.2, pp IV.44-IV.58) **Decontamination and decommissioning of a fuel reprocessing pilot plant, a progress report.** Speer, D.R. (Rockwell Hanford Operations, Richland, WA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Strontium Semiworks complex on the Hanford Site operated as a pilot plant from 1949 to 1967 to develop two different methods for fuels reprocessing and a method for separating strontium from high level liquid waste. The complex was maintained in safe storage from 1967 until 1983 when the decision was made to decontaminate and decommission the plant. Alternatives considered were: (1) earthen entombment without demolition; (2) partial dismantlement/entombment; (3) razing of all above ground structures; (4) total dismantlement; and (5) no action. An Environmental Assessment was prepared for the project in 1984 and a Finding of No Significant Impact was issued on May 15, 1985. The approved method of decommissioning was Alternative 2 based upon stability of the end product, cost of the project, and projected impacts. As of July 1987 three buildings have been decontaminated, two buildings have been completely dismantled, and the main process building has been partially dismantled and entombed. Remaining work includes cleaning out a 190,000-L (50,000 gal.) tank, decontaminating and demolishing a 61-m (200-ft) stack, entombing an exhaust filter system, and placing an engineered barrier over the entombed facilities.

7263 (CONF-871018—Vol.2, pp IV.59-IV.74) **Spent fuel pool cleanup and stabilization.** Miller, R.L. (UNC Nuclear Industries, Richland, WA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Each of plutonium production reactors at Hanford had a large water-filled spent fuel pool to provide interim storage of irradiated fuel while awaiting shipment to the separation facilities. After cessation of reactor operations the fuel was removed from the pools and the water levels were drawn down to a 5- to 10-foot depth. The pools were maintained with the water to provide shielding and radiological control. What appeared to be a straight forward project to process the water, remove the sediments from the basin, and stabilize the contamination on the floors and walls became a very complex and time consuming operation. The sediment characteristics varied from pool to pool, the ion exchange system required modification, areas of hard-pack sediments were discovered on the floors, special arrangements to handle and package high dose rate items for shipment were required, and contract problems ensued with the subcontractor. The original schedule to complete the project from preliminary engineering to final stabilization of the pools was 15 months. The actual time required was about 25 months. The original cost estimate to perform the work was 2,651,000. The actual cost of the project was $5,120,000, which included $150,000 for payment of claims to the subcontractor. The experiences associated with the cleanup and radiological stabilization of the 100-B, -C, -D, and -DR spent fuel pools, and discusses a number of lessons learned items are summarized.

7264 (CONF-871018—Vol.2, pp IV.75-IV.85) **Decontamination technology: a US perspective.** Allen, R.P. (Pacific Northwest Lab., Richland, WA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Substantial progress has been made in the US since the 1982 International Decommissioning Symposium in developing, demonstrating and applying chemical and selected nonchemical decontamination techniques. Although much of this progress has been motivated by the decontamination requirements of operating facilities, the resulting technology is directly applicable to decommissioning-related decontamination needs. An overview of these advances and applications is presented to provide a US perspective for the decontamination technology and applications presented at the 1987 Symposium.

7265 (CONF-871018—Vol.2, pp IV.134-IV.152) **Decontamination of uranium-contaminated equipment and parts.** Xianwen, R.; Suyun, Q.; Mingcai, Q.; Lianquan, Z.; Dahai, D. (Institute for Radiation Protection MNI, Shanxi, China). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A Uranium enrichment pilot plant was decommissioned in 1985-1986. The decontamination concept and methods and results for the equipment and parts decontaminated are discussed. The kinds of metals involved in the decontamination action were copper, nickel, aluminium alloy, mild steel, and stainless steel. Decontamination results showed the surface contamination levels of most parts decontaminated achieved the required level. The uranium content in aluminium ingots after metal refining was from 33 to 232 ppm. The decontamination liquid wastes were treated with the multiprecipitation method. The contents of uranium, nickel, and fluoride in the supernatant were 0.02-0.1 mg/1, 0.02 mg/1, and 0.13 mg/1, respectively.

7266 (CONF-871018—Vol.2, pp IV.217-IV.229) **New method for decontamination of concrete with milling cutter.** Funakawa, N.; Kinoshita, T.; Tanaka, T. (Sato Kogyo Co., Ltd., Tokyo, Japan). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The techniques up to this time for removing contaminated concrete surfaces have some problems, such as irregular depth of removal, difficulty of collecting the scraped debris and so on. As a solution of these problems, a new method with original milling cutter and vacuum collecting system had been developed. The milling cutter can scrape the concrete surface to a few millimeters depth accurately by one pass. The scraped debris is shaped uniform powder and is collected almost 100% by a vacuum collecting system. This method has many advantages, such as radioactive waste reduction, prevention from internal exposure of workers, recontamination prevention and easy measurement of residual radioactivity after decontamination. The development, demonstration, experience and outline of the new method completed as Clean Cut Removal System are discussed.

7267 (CONF-871018—Vol.2, pp IV.230-IV.239) **Metal segmenting using abrasive and reciprocating saws.** Allen, R.P.; Fetrow, L.K.; Haun, F.E. Jr. (Pacific Northwest Lab., Richland, WA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The results are presented of a study conducted at the Pacific Northwest Laboratory (PNL) under US Department of Energy sponsorship to evaluate a light-weight, high-power abrasive saw for segmenting radioactively contaminated metal components. A unique application of a reciprocating mechanical saw for the remote disassembly of equipment in a hot cell also is described. The results of this work suggest that use of these techniques for selected remote sectioning applications could minimize operational and access problems and be very cost-effective in comparison with other inherently faster sectioning methods.

7268 (CONF-871018—Vol.2, pp IV.238-IV.242) **High efficiency suction system for use in controlled areas.** Beyer, V. (Power Clean Industry Reininguns- + HandelsgmbH, Mannheim, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

For more than six years special equipment of the following specifications has been employed in the course of back-fitting, revision and decommissioning operations in nuclear units. The main components of the system are: the suction and conveyor hose (inner diameter up to 100 mm), the blower with electric drive, and the rubble and dust separator including a precleaner (cyclone) and high-efficiency particulate filters. Precleaner, filters, and blower are mounted in a mobile rack. The conveyed materials are directly dis-

charged into drums or container for subsequent further conditioning. The system is capable of suctioning and conveying pneumatically: dusts of various consistency; rubble and rubbish of concrete and brickwork; ion exchanger and filter materials, e.g., charcoal, resins, diatomite, and sand; insulating materials, e.g., asbestos, stone and glass wool; and sludges and residual liquids. The vacuum system is described.

7269 (CONF-871018—Vol.2, pp IV.258-IV.269) **Overview of plutonium-238 decontamination & decommissioning (D & D) projects at Mound.** Bond, W.H.; Davis, W.P.; Draper, D.G.; Geichman, J.R.; Harris, J.C.; Jaeger, R.R.; Sohn, R.L. (Monsanto Research Corp., Mound, Miamisburg, OH). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Monsanto Research Corporation (MRC), which operates the Mound Site (in suburban Dayton, Ohio) for the Department of Energy (DOE), has been decommissioning radioactively contaminated facilities since 1949. Mound is currently decontaminating (for restricted reuse) and/or decommissioning (for conditional release) four major plutonium-238 contaminated facilities (approximately 75,000 $ft^2$) that contained 1700 linear feet of gloveboxes and associated equipment and services. In addition, several thousand linear feet of external underground piping, associated tanks and contaminated soil are being removed. Two of the facilities contain ongoing operations and will be reused for both radioactive and nonradioactive programs. Two others will be completely demolished and the land area will become available for future DOE building sites. Currently, over 30,000 Curies of plutonium-238 have been removed in waste and scrap residues. An overview of the successful techniques and equipment used in the decontamination and decommissioning of individual pieces of equipment, gloveboxes, services, laboratories, sections of buildings, entire buildings, and external underground piping, tanks, and soil in a highly populated residential area is described and pictorially presented.

7270 (CONF-871018—Vol.2, pp IV.339-IV.349) **Radiological characterization: strategy to avoid surprise.** Haywood, F.F.; Brown, J.A. (Eberline Analytical Corp., Oak Ridge, TN). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Radiological characterizations are designed to gather information about the current status of a property, or site. Site, as used here, represents a parcel of open land, or one with improvements. Radiological characterizations, specifically those which are a part of major remedial action programs are discussed. The principal objective of this work is to determine the distribution of contaminants within and around a site boundary. Results may be required as input for engineering assessments and for remedial action design. Inadequately planned and executed characterizations can lead to inaccurate estimates of waste volumes, to expanded field measurements, and to delays in construction. Since funding for all remedial activities is shared, there is a strong incentive to make efficient use of available resources. TMA/Eberline Analytical has over 15 years experience in providing radiological support for remedial actions including the clean up of nuclear weapon test areas, uranium processing facilities, and other radiologically contaminated structures. It is believed that careful consideration of the discussions presented will help to minimize surprises once remedial action begins.

7271 (CONF-871018—Vol.2, pp IV.368-IV.378) **Waste packages from decommissioning: characterization, constraints and disposal risk.** Alder, J.C. (National Cooperative for the Storage of Radioactive Waste (Nagra), Baden, Switzerland). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In Switzerland projects have been prepared by Nagra for demonstrating the feasibility of safe disposal for all types of nuclear wastes. The management of the decommissioning waste has been thus in a first approach covered fully from dismantling studies of the 4 Swiss nuclear plants, through waste conditioning and packaging, up to disposal in a specified repository with corresponding safety assessment. The main lessons learned from the links between the different steps are presented and are summarized with emphasis on the heat producing waste packages which are one of the main concerns.

7272 (CONF-871018—Vol.2, pp IV.394-IV.404) **Proposed decommissioning of radioactively contaminated NaK.** Brown, B.W.; Geimer, R.M.; LaRue, D.M.; Stoll, F.E.; Meservey, R.H.; Voldness, C.M. (Idaho National Engineering Lab., Idaho Falls). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A proposed method for stabilizing radioactively contaminated eutectic sodium/potassium (NaK) liquid metal is described. Approximately 680 liters (180 gal) of contaminated liquid NaK were generated in 1955 during testing with the Experimental Breeder Reactor (EBR-I) at the Idaho National Engineering Laboratory (INEL). Reaction of the NaK with chlorine gas to produce solid salts of sodium and potassium is proposed as a means to stabilize this waste. Preliminary testing was initiated to determine the reaction conditions required for this process. It was found that reaction with chlorine is feasible for safely treating the liquid metal.

7273 (CONF-871018—Vol.2, pp V.1-V.15) **Estimating volume of contaminated soil for excavation: a quick and simple method.** Robinet, M.J.; Wynveen, R.A. (Argonne National Lab., IL). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Estimates of the volume of radionuclide contaminated soil which must be excavated require data on the depth distribution of the contamination. Using a novel uncomplicated approach, vertical activity distribution data were obtained on a 1400 $m^2$ site. The volume of contaminated soil which had to be excavated was estimated to be between 227 and 425 $m^3$. When the site cleanup was done, 312 $m^3$ of contaminated soil had to be removed to satisfy the cleanup criteria. The basic approach was to drill 193 holes over the entire site and to make measurements in each using a detector with a side-looking collimator. Soil samples from the holes were analyzed only to the extent necessary to obtain sufficient data for demonstrating a correlation between count rate and activity concentration in the soil. The site was then conceptually sliced into vertical strips of contamination concern. The product of the contamination depths which exceeded cleanup criteria and the areas of the slices gave the volume of excavation required.

7274 (CONF-871018—Vol.2, pp V.56-V.66) **Decommissioning project readiness reviews at the Department of Energy's Hanford, Washington, Site.** Speer, D.R.; Holmes, P.A. (Rockwell Hanford Operations, Richland, WA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Two Hanford Site contractors independently formulated readiness review methods to prepare for decontamination and decommissioning (D & D) projects. One readiness review method provided an independent management review process. The other method provided a review by personnel directly involved in the project and concise documentation procedures. A unified system is now used at Hanford which combines the best aspects of both readiness review methods. The unified method assigns category levels based on certain job characteristics. The category assigned to the project then indicates the required level of management review prior to proceeding with the D & D project. In addition, the concise documentation procedures are now used for all category levels.

7275 (CONF-871018—Vol.2, pp V.89-V.103) **Estimation of the risk from residual radioactivity.** Niemczyk, S.J. (Gull Associates, Washington, DC). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987)

A new approach for estimating the potential radiation hazard from residual radioactivity at decontaminated sites and facilities has recently been developed to aid the USEPA's selection of decommissioning criteria for regulatory purposes. The approach is intended to generate conservatively realistic estimates of radiation doses to onsite residents from radioactivity both in the environment and in buildings. It does so using a comprehensive yet relatively simple set of physically-based, state-of-the-art risk-level environmental transport and exposure pathway models. The transport models have been interfaced to permit time-dependent, mechanistic consideration of radioactive transfers within and among the various environmental media. Radioactive decay and ingrowth are explicitly accounted for. Doses in contaminated multiroom buildings are estimated using a set of unique transport and exposure models. The overall approach has been encoded in a computer code REUSEIT which runs on a personal computer.

7276 (CONF-871018—Vol.2, pp V.129-V.134) **Automation of the radiological survey process: USRADS Ultrasonic Ranging and Data System.** Berven, B.A.; Blair, M.S.; Little, C.A. (Oak Ridge National Lab., TN). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Radiological Survey Activities (RASA) program at Oak Ridge National Laboratory (ORNL) serves as the Inclusion Survey Contractor (ISC) in the Department of Energy's (DOE) Uranium Mill Tailings Remedial Action Project (UMTRAP). The ISC is required to identify properties in the vicinity of 24 inactive uranium mill sites where presence of uranium mill tailings is suspected. Tailings are $^{226}$-Ra-bearing by-product originating from the processing of uranium ore. Mobile gamma scanning is the primary method used to identify these properties. Once identified, the ISC conducts an inclusion survey on the property. The objective of this survey is to perform sufficient radiological measurements to determine if uranium mill tailing contamination is present, and, if so, if it is in excess of relevant Environmental Protection Agency (EPA) criteria. Radon gas emanating from $^{226}$Ra is the primary component of exposure to human occupants at these sites. EPA criteria focus on controlling $^{226}$Ra concentrations in soil. ORNL was requested to perform 8000 vicinity property inclusion surveys in three years in the communities near 24 inactive mill sites. In an effort to conduct this radiological survey activity in the most cost-effective manner possible, ORNL developed a technology to automate much of the radiological survey process and provide tabular and graphical survey data output in the field or in the office for report generation. This technological development is called the UltraSonic Ranging and Data System (USRADS).

7277 (CONF-871018—Vol.2, pp V.135-V.145) **Health physics procedures in the removal of contaminated external ducts in a populated area.** Draper, D.G.; Davis, W.P.; Garner, J.M.; Geichman, J.R. (Monsanto Research Corp., Mound, Miamisburg, OH). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Special Metallurgical (SM) Building at the US Department of Energy facility located in Miamisburg, Ohio is currently in the decommissioning process. An early task in this project was the removal of external ductwork which was highly contaminated with plutonium-238. Approximately 450 linear feet of duct which averaged three feet in diameter were included in the project. One duct, approximately 150 feet in length, connected an external filter bank with a stack plenum and was moderately contaminated. This duct was removed first so that contamination control techniques could be developed for use later in the removal of the second duct which was highly contaminated. Because SM Building is located approximately 100 meters from the fenceline procedures were required which offered a high degree of assurance that airborne release of contamination would be strictly controlled. Special fixation techniques, decontamination methods, and other procedures were employed in the removal of the ductwork and subsequent removal and replacement of the roof.

7278 (CONF-871018—Vol.2, pp VI.1-VI.13) **Methodology for selecting tooling and telemanipulated equipments for a decommissioning project.** Clement, G.; Fraize, G.; Antoine, P.; Cregut, A. (CEA, Fontenay aux Roses, France). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The end effector aspect of a remote handling machine dedicated to dismantling nuclear facilities is discussed. End effector comprises the toolings and tool handling device (the manipulator). The end effector is placed at work using a transporter. Desirable qualities of toolings (analysis is voluntarily limited to metal cutting processes) are discussed with respect to the particular dismantling application. Comparisons are presented and discussed in order to help in the selection in front of a given project. A similar approach is presented concerning manipulators, quality parameters are proposed and discussed considering three major classes of machines: power manipulators, servomanipulators, and industrial robots. An a priori and universal choice is not reasonable to consider particularly because of the basic duality of decommissioning activity: the project revolves around waste identity which is the key product, and the production plant design has to comply with an existing facility and all the corresponding constraints. In conclusion, the possible development of orientations are proposed considering a new field of investigation which addresses small size devices and work in parallel with multiple machines to reduce costs and down times. Decommissioning projects of the future may be looked at as flexible workshops.

7279 **(DP-MS—87-3) Calculation of three-dimensional groundwater transport using second-order moments.** Pepper, D.W.; Stephenson, D.E. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 16p. (CONF-8710141—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014838/JAW.

From International conference on groundwater contamination; Amsterdam, Netherlands (26 Oct 1987).

Groundwater transport of contaminants from the F-Area seepage basin at the Savannah River Plant (SRP) was calculated using a three-dimensional, second-order moment technique. The numerical method calculates the zero, first, and second moment distributions of concentration within a cell volume. By summing the moments over the entire solution domain, and using a Lagrangian advection scheme, concentrations are transported without numerical dispersion errors. Velocities obtained from field tests are extrapolated and interpolated to all nodal points; a variational analysis is performed over the three-dimensional velocity field to ensure mass consistency. Transport predictions are calculated out to 12,000 days. 28 refs., 9 figs.

7280 **(DP-MS—87-71) Storage vault for uranium oxide.** Hooker, G.J.; Coleman, H.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 3p. (CONF-871110—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002441/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

The conceptual design of a vault for storage of uranium oxide has been evaluated. Unique features of the proposed design are the storage racks, radiation shielding, and the method of surveillance. These features, with appropriate modifications, can be retrofitted to existing vaults.

7281 **(DPST—85-708) Ford Building Waste Site: Environmental information document.** Huber, L.A.; Holmes, W.G.; Simmons, R.V.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88000761/JAW.

The Ford Building Waste Site is located north of the Ford Building in the Central Shops Area of the Savannah River Plant (SRP). Evidence indicates that work with potential for radioactive contamination was performed in the area and that the protective clothing worn by the personnel was disposed of at the site. The

closure options considered for the Ford Building Waste Site are waste removal and closure, no waste removal and closure, and no action. No human health risk calculations were performed for this site because no materials disposed at the site were identified as presenting a health or environmental risk. A cost analysis, proposed for each closure option, shows that the removal of surface soils from the Ford Building Waste Site and disposal in a waste storage/disposal facility is more expensive than site maintenance and monitoring under the other two options. 16 refs., 12 figs., 10 tabs.

7282 **(EIR—630) Solidification of radioactive wastes with sulphur. Investigation of the leaching mechanism.** Rietmann, K.B. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Sep 1987. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700789/JAW.

The possibilities were studied of using sulfur as an additive and as the matrix material in the solidification of low and medium level radioactive waste. The leaching mechanism in the various resulting solid materials was investigated. Concentrated boric acid, aqueous waste and loaded ion-exchange resins were used as models of the radioactive waste. This selection allowed us to compare our results with literature data. For the characterization of the solidification and comparison with literature data we measured the leaching rate of inactive cesium and cobalt, the stability in water and the compressive strength. To investigate the leaching mechanism, we measured porosity and the sulfide concentration in the leaching liquid. The cesium and cobalt concentrations were determined by absorption spectrometry, the sulfide concentrations with an ion-selective silver/sulfide electrode. In the first phase, we tried to improve cement solidification by either adding sulfur to the cement-waste mixture or by impregnating the cement in molten sulfur. The addition of sulfur to the cement-mixture produced worse characteristics, impregnation with 5 % sulfur lowered the leaching rate and increased the compressive strength by a factor of three. Sulfur as the matrix poses other problems. In the presence of alkaline earth metals and at high pH-values we observed a substantial production of sulfide ion. The formation of soluble sulfide complexes increased the leaching rate. This problem was solved by adding Clinoptilolite in H/sup +/-form to buffer the pH-value at acceptable values. The study shows that the mechanism of leaching for Cs and Co out of the cement or the sulfur matrix is diffusion controlled. With sulfur matrices at high sulfide concentrations erosion is the dominating mechanism for bringing cesium and cobalt into the leaching fluid.

7283 **(EUR—10521) Washing processes for plutonium recovery from solid wastes.** Ledebrink, F.W. (ALKEM, Hanau, Germany, F.R.). (Commission of the European Communities, Luxembourg). 1986. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751380/JAW.

The recovery of plutonium from primary wastes by means of washing processes has been investigated and demonstrated on a laboratory scale. For both ecological as well as economic reasons it is reasonable to recover plutonium from these wastes. It can be concluded that with the correct coordination of washing procedures with waste composition, the bulk of plutonium can be recovered with very little expenditure.

7284 **(EUR—10804) Design study on containers for geological disposal of high-level radioactive waste. Phase 2.** (Commission of the European Communities, Luxembourg). 1986. 171p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751381/JAW.

This study has considered the feasibility of three designs for containers which would isolate the waste from the environment for a minimum period of 500 to 1000 years. The candidate container designs were taken from the results of a previous study by Ove Arup and Partners (1985) and were developed as the study progressed. Their major features can be summarized as follows: Type A: A thin-walled corrosion-resistant metal shell filled with lead or cement grout. Type B: An unfilled thick-walled carbon steel shell. Type C: an unfilled carbon steel shell plated externally with corrosion-resistant metal. Reference repository conditions in clay, granite and salt, reference disposal operations and metals corrosion data have been taken from various European Community radioactive waste management research and engineering projects. The study concludes that design types A and B are feasible in manufacturing terms but design Type C is not. Furthermore, a titanium-palladium alloy is considered the most suitable metal for Type A container shells and lead is the preferred filler. The analysis shows that design Types A and B both have adequate resistance to pressure and temperature loadings and both would resist accidental impact damage when upright. A reduction in waste heat output at disposal would lower the stress levels in Type A containers but would have virtually no effect on Type B. There is insufficient data to compare the relative costs and benefits of design Types A and B. In conclusion design Types A and B are both considered feasible but Type A would require more development than Type B. In both cases further research is needed to confirm the long-term corrosion performance of the candidate materials. It is recommended that model containers should be produced to demonstrate the proposed methods of manufacture and that they should be tested to validate the analytical techniques used.

7285 **(EUR—10816) Radiological impact of shallow land burial: sensitivity to site characteristics and engineered features of burial facilities.** Pinner, A.V., Maple, J.P. (National Radiological Protection Board, Chilton, UK). (Commission of the European Communities, Luxembourg). 1986. 95p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751382/JAW.

In recent years there has been an increasing interest in disposal of low-level solid radioactive wastes in engineered trenches located at shallow depth. This report describes an assessment of the radiological impact of disposal by shallow burial of low-level wastes in two kinds of low permeability geological media sited either inland or on the coast. Radionuclide release mechanisms include contact by ground-water and human intrusion. Calculations have been carried out for disposal of unit quantities of radionuclides and for disposal of notional quantities of LWR and Magnox reactor operating wastes. The sensitivity of the predicted radiological impact has been examined in relation to assumptions for repository design and to assumptions for the hydrogeological properties of the engineered barriers and for waste packaging or conditioning.

7286 **(EUR—10827(v.1)) Results of temperature test 6 in the Asse salt mine. Volume 1 - Main report.** Feddersen, H.; Flach, D.; Flentge, I. and others. (Gesellschaft fuer Strahlen; Umweltforschung, Muenchen, Germany, F.R. ). (Commission of the European Communities, Luxembourg). 1986. 278p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751383/JAW.

In the year 1985 a heater test with a mean heat load of 50 kW was carried out in the Asse salt mine for 78 days. Its main aims were to investigate possible fracturing of the rock; investigations on the transport of brine and gases; comparison of the measured mechanical stresses and temperatures, as compared to those determined by numerical methods. The evaluation of the measurement results was impeded by premature failure of some of the heaters, which proved to be a handicap to the symmetry of the experiment. It was possible, nevertheless, to find a good agreement between the measured and the numerically calculated temperatures. The mechanical stress measurements showed, as compared to the 2D-FE-calculations, that the measured stresses lay within the expected range. Fracturing was detected by means of seismic observations, especially after termination of the heating. Brine transport was ascertained using geoelectric four point -and self-potential measurements. The staining test showed no sharp fracturing of the rock salt, but a loosened-up zone at the grain boundaries impregnated with staining oil.

7287 **(EUR—10827(v.2)) Results of temperature test 6 in the Asse salt mine. Volume 2 - Appendix.** Feddersen, H.; Flach, D.; Flentge, I. and others. (Gesellschaft fuer Strahlen; Umweltforschung, Muenchen, Germany, F.R. ). (Commission of the European Communities, Luxembourg). 1986. 255p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88751384/JAW.

In the year 1985 a heater test with a mean heat load of 50 kW was carried out in the Asse salt mine for 78 days. Its main aims

were to investigate possible fracturing of the rock; investigations on the transport of brine and gases; comparison of the measured mechanical stresses and temperatures, as compared to those determined by numerical methods. The evaluation of the measurement results was impeded by premature failure of some of the heaters, which proved to be a handicap to the symmetry of the experiment. It was possible, nevertheless, to find a good agreement between the measured and the numerically calculated temperatures. The mechanical stress measurements showed, as compared to the 2D-FE-calculations, that the measured stresses lay within the expected range. Fracturing was detected by means of seismic observations, especially after termination of the heating. Brine transport was ascertained using geoelectric four point -and self-potential measurements. The staining test showed no sharp fracturing of the rock salt, but a loosened-up zone at the grain boundaries impregnated with staining oil.

7288 **(EUR—10847(v.2)) Characterisation of candidate buffer materials. Vol. 2: Thermo-mechanical calculation of buffer in granitic environment.** Broc, D. (CEA CEN Fontenay-aux-Roses, 92, France. IRDI, DRDD). (Commission of the European Communities, Luxembourg). 1987. 150p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751385/JAW.

Mechanical stresses of compacted clays between the canister and the host rock are studied in the different cases during evolution of a vitrified waste storage site. Thermal stress variations are studied in function of time and thermal power decrease of stored wastes and of materials characteristics and behavior. Consequences of stresses produced by partial hydratation of clays are evaluated. The study concludes that an argillaceous containment does not present a rupture risk, even during a partial hydratation in addition stresses on stored packaging are obtained.

7289 **(EUR—10848) A feasibility study for the design of a simulated radioactive waste repository facility: Volume 1: Final report.** (Mott, Hay and Anderson, Croydon (UK); Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development). 1987. 142p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88900105/JAW.

The need for a full scale experimental program to investigate buffer placement and performance was identified. The nature of candidate buffer materials and the factors defining their behavior is reviewed and the nature of a buffer material selection and testing program is outlined. The properties of crystalline rocks, saliferous formations and clay host materials is reviewed and the complex interactions between them is identified. The difficulty of modeling these properties and the interaction between buffer and host materials is discussed and the instrumentation requirements for measuring this interaction is outlined. A limited amount of thermomechanical analysis is performed to give a preliminary indication of the parameters of major significance in selection of instrumentation and modeling materials. A complete simulation of host material properties is not presently viable, although it may be attainable for some crystalline rock types. Alternative strategies for assessment of the host/buffer interaction are suggested. 52 refs.

7290 **(EUR—10924) Calibration of mathematical models for simulation of thermal, seepage and mechanical behaviour of boom clay.** Baldi, G.; Borsetto, M.; Hueckel, T. (Ismes, Bergamo, Italy). (Commission of the European Communities, Luxembourg). 1987. 225p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751386/JAW.

This report presents results of research on the verification of the validity of a generalized thermo-elastoplastic-hydraulic mathematical model elaborated at Ismes for description of the behaviour of boom clay. The model is described in Section 2. Experimental results performed at Ismes for the identification of the material constants in athermal and thermal drained conditions are then presented. Procedures for the identification are described in Section 4. The undrained consolidated constant total stress heating test is then discussed. The undrained test shows the possibility of clay yielding due to effective pressure decrease during heating, caused by water pressure growth. The test has been simulated numerically, confirming the interpretation of the experiment. Further simulation of plane strain and plane stress central heating axisymmetric problem shows again a formation of a yielded clay zone around the heater. Interpretation of the results and recommendations for further research are given.

7291 **(EUR—10926) Fluid and ionic transport properties of deformed salt rock.** Peach, C.J.; Spiers, C.J.; Tankink, A.J.; Zwart, H.J. (Ultrecht Univ., Netherlands). (Commission of the European Communities, Luxembourg). 1987. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751387/JAW.

This is a final report on work done on the transport properties of salt during the period 1 January 1984 to 30 June 1985. This work was directed largely at the measurement of creep-induced permeability in salt rock, at determining the permeability persistence/decay characteristics of creep-dilated salt rock under hydrostatic conditions, and at ion migration/retention experiments on both deformed and undeformed material. The permeability work was carried out using both gas (argon) and brine, and involved the design and construction of corresponding permeametry systems for use in conjunction with dilatometric triaxial testing apparatus. Ion migration/retention studies involved the use of contaminant species such as Sr/sup 2+/, Ca/sup +/, Fe/sup 3+/ and TcO/sub 4/.

7292 **(EUR—10973) Measurement of the vertical component of hydraulic conductivity in single-cased and uncased boreholes.** Black, J.H.; Noy, D.J.; Brightman, M.A. (British Geological Survey, Nottingham, UK). (Commission of the European Communities, Luxembourg). 1987. 67p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751388/JAW.

The project aimed to assess the different existing methods of measuring vertical hydraulic conductivity in single boreholes by carrying out some actual field testing. A review of existing techniques for both field practice and analysis of the results is reported. After consideration of the various techniques a combination method of testing is proposed. A set of equipment to carry out this combination of tests was designed and built. The uncased testing revealed that it was possible to derive a value for vertical hydraulic conductivity. The doublet method, however, was not particularly successful and numerical simulation was cumbersome. The type-curve approach of appraising whether or not analysis concepts were appropriate proved the most robust method. It is clear that reconnaissance measurements of environmental pressure are very useful in defining where detailed testing should take place. The second phase of testing through perforations proved very difficult. There were many problems associated with location both of the wireline testing system within the borehole and especially of the previous measurements. However, analysis of the results in terms of skin indicated that the perforations produced a negative skin. The measurement of vertical hydraulic conductivity cannot at the moment be regarded as routine.

7293 **(EUR—10987) Geotechnical characterization of boom clay in relation to the disposal of radioactive waste.** Horseman, S.T.; Winter, M.G.; Entwistle, D.C. (British Geological Survey, Keyworth; Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development). 1987. 98p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900103/JAW.

This report describes the results of a laboratory study on the geotechnical properties of the Tertiary Boom clay. Tests were performed on undisturbed samples of clay taken from a location 247 m below surface at the experimental site at Mol in Belgium. In geotechnical terms, the Boom clay may be described as a hard, high-plasticity, overconsolidated clay. Test methods have included the one-dimensional consolidation test with consolidation stresses up to 32 MPa, the one-dimensional swelling pressure test, the isotropically-consolidated, undrained triaxial test with pore pressure measurement, and the unconsolidated undrained triaxial test. All triaxial tests were load-controlled. Limited test results are presented on pore pressure responses during heating under undrained conditions and on the effect of elevated temperature (80°C) on deformability and strength. It is found that significantly large excess pore pres-

sures may be developed during heating from ambient laboratory temperature to 80°C. The effect is due, at least in part, to the expansion of the pore fluid. 39 figs., 20 tabs.

7294 **(GSF—1/85) Leaching experiments with real-scale specimens in the Asse abandoned shaft. Period covered: 1979-1985.** Hinsch, H.; Kessler, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.)). Mar 1985. 25p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751272/JAW.

The experiments are carried out in order to obtain data describing the incident of water or brine intrusion into a nuclear waste repository. The specimens used are real-scale, solidified waste dummies. The solidification matrix is the first barrier against release of radioactivity, and the experiments studied the long-term release of the nuclides, e.g. Cs-137 and U, as a result of cement corrosion.

7295 **(JAERI-M—87-124) Development of partial models of comprehensive safety assessment model for shallow land disposal of low level radioactive wastes, 2. Simulation model for the release of radionuclides from an engineered barrier (ENBAR).** Matsuzuru, Hideo; Kurosawa, Naohiro; Suzuki, Atuyuki. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 49p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751445/JAW.

Simulation model (ENBAR) for release of radionuclides from an engineered barrier has been developed to evaluate the source term for subsequent migration of radionuclides in and through a natural barrier. The system postulated here is that a waste package (waste form and container) is placed, together with backfill materials, into a concrete pit as a diposal facility which is constructed near subsurface. The model includes following modules; 1) Water balances on the ground surface and in a concrete pit. 2) Leaching of radionuclides from a waste package, by convolution of the leaching of radionuclides from a waste form and the corrosion of a container. 3) Breakage of the pit for estimating the amounts of water penetrating into the pit and leaking from the pit. 4) Migration of radionuclides in and through backfill materials. 5) Release of radionuclides from the pit. The main advantages of the ENBAR are its simplicity of operation and presentation while still allowing comprehensive evaluation of each element of an engineered barrier to be treated. The performance and source term of the facility might be readily estimated with relatively few key parameters to define the problem.

7296 **(YJT—87-04) Loviisa Power Station - final disposal of reactor waste. Shutdown and sealing of the repository.** Vaajasaari, Marja. (Technical Research Centre of Finland, Espoo. Geotechnical Lab.). (Voimayhtioeiden Ydinjaetetoimikunta, Helsinki (Finland)). Jan 1987. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751322/JAW.

This report is based on the earlier published results of research into the properties and function of the candidate backfill materials. The results of the backfill material research, and the sealing concepts presented in the literature have been evaluatedand applied to sealing the Loviisa Reactor Waste Repository taking into consideration the local rock and groundwater conditions. It is emphasised that the applicability of the presented backfill materials and plugs to repository sealing must still be carefully evaluated on the basis of detailed studies and the local environment. 24 refs.

7297 **Important radionuclides in high level nuclear waste disposal: Determination using a comparison of the U.S. EPA and NRC regulations.** Oversby, V.M. (Earth Sciences Dept., Lawrence Livermore National Lab., Livermore, CA). *Nuclear and Chemical Waste Management;* 7: No. 2, 149-162(1987). Contract W-7405-ENG-48.

The performance objective for the engineered barrier system given in the NRC regulations (10CFR60) is used to determine a maximum release rate for each significant radionuclide for a generic repository containing PWR spent fuel. This release rate, integrated over the times during which release would occur, is then compared to the U.S. EPA requirements on limitation of total releases to the accessible environment. The amount by which the releases allowed under the NRC regulations exceeds the U.S. EPA requirements is an indication of the importance of the radionuclide for performance assessment purposes. Americium and plutonium are by far the most important. The other actinides, carbon, and nickel are also important. If the assumption of congruent dissolution is imposed, with a 1% rapid release spike for cesium, iodine, carbon, and technetium, the list of elements reduces to 13, with iodine, cesium, selenium, and palladium being eliminated from the list. The importance of americium is greatly reduced in this case and plutonium becomes the most important element. A final analysis, which assumed a congruent dissolution rate of one part in 1,000,000 per year, results in a list of at most seven important elements.

## 0530 Environmental Aspects

*REFER ALSO TO CITATION(S) 7279, 7281, 7289, 7297*

7298 **(PB—87-231973/XAB) Environmental contaminants in birds: phosphate-mine and natural wetlands. Final report.** O'Meara, T.E.; Marion, W.R.; Roessler, C.E.; Roessler, G.S.; Van Rinsvelt, H.A. (Florida Univ., Gainesville (USA)). Nov 1986. 83p. NTIS, PC A05/MF A01.

Large ponds used to settle the waste clays from Florida's phosphate surface-mining operations are attractive to waterfowl, and contain elevated levels of trace elements and radionuclides of the uranium-series naturally associated with phosphate ore. Four species of waterfowl were sampled to investigate accumulation of radionuclides and trace elements and to evaluate potential deleterious effects for the birds and humans consuming them. Greater radium-226 levels in the substrate of the settling ponds than in natural wetlands were reflected in elevated concentrations in bones for all four species. Diet/substrate ratios were less than 1 for all species in all areas. Bone/substrate ratios differed between settling areas and natural wetlands. Radium-226 levels in soft tissues were consistently less than those in bones, and did not appear to represent an increased threat to humans eating the tissue.

## 0550 Safeguards, Inspection, And Accountability

*REFER ALSO TO CITATION(S) 7280, 7685, 7688*

7299 **(IAEA-STR—223) Some basic concepts of fast breeder reactor safeguards.** Tkharev, E.; Walford, F.J. (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Apr 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700801/JAW.

The range of discussion topics of this report is restricted to a few key areas of safeguards importance at Fast Breeder Reactors (FBR) only. The differences between thermal and fast reactors that may have safeguards significance in the case of FBRs are listed. The FBR principles of design are mentioned. The relevant safeguards objectives and criteria are given. The fundamental issues for safeguarding FBR are treated. An outline safeguards approach is presented. Model inspection activities are mentioned. 4 figs.

7300 **(IAEA-STR—231(Rev.0)) Random selection of items. Selection of n/sub 1/ samples among N items composing a stratum.** Jaech, J.L.; Lemaire, R.J. (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Feb 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700802/JAW.

STR-224 provides generalized procedures to determine required sample sizes, for instance in the course of a Physical Inventory Verification at Bulk Handling Facilities. The present report describes procedures to generate random numbers and select groups of items to be verified in a given stratum through each of the measurement methods involved in the verification. (author). 3 refs.

### 0560 Legislation And Regulations

*REFER ALSO TO CITATION(S) 7297*

## 07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

### 0701 Physical Isotope Separation

7301 **Large-scale calcium metal sample preparation for / sup 41/Ca isotope enrichment.** Henning, W.; Liu, Z.; Lucas, H.F.; Thomas, G.E.; Adair, H.L.; Grisham, W.B. (Argonne National Lab., IL, USA; Oak Ridge National Lab., TN, USA). *Nuclear Instruments and Methods in Physics Research;* 257: No. 1, 60-63(1 Jun 1987). (CONF-860939—). Contract W-31-109-ENG-38.

From 13. world conference of the Nuclear Target Development Society; Chalk River, Canada (17 Sep 1986).

Experiments are underway at Argonne National Laboratory to measure the /sup 41/Ca radioisotope concentration (T/sub 1/2/ = 100,000 years) in natural samples of terrestrial origin by accelerator mass spectrometry (AMS). Since the concentration of /sup 41/Ca in these samples is expected to be very low, enrichment with a Calutron Isotope Separator at Oak Ridge National Laboratory is being used. This separator requires rather large quantities of high-purity Ca metal (typically 100 g/loading) as source material. Details of the methods of obtaining these metallic samples from various materials will be presented.

7302 **Evolution and application of the seismic qualification program on the GCEP project.** Drake, R.M.; Smietana, E.A.; Richter, P.J.; Beavers, J.E. (Fluor Technology, Inc., Irvine, CA). pp 2261-2270 of Proceedings of the third U.S. national conference on earthquake engineering. Volume 3. El Cerrito, CA; Earthquake Engineering Research Institute (1986). (CONF-860816—).

From 3. U.S. national conference on earthquake engineering; Charleston, SC, USA (24 Aug 1986).

The Gas Centrifuge Enrichment Plant (GCEP) seismic qualification program underwent a number of evolutionary changes over a period of approximately seven years. These changes reflect a general industry trend toward more rational and cost-effective approaches to seismic qualification. Such approaches recognize and encourage the use of experience and engineering judgement. The three distinct evolutionary phases of the GCEP seismic qualification program are discussed including the philosophy and qualification methodology associated with each. The approach to seismic qualification in the third phase led to significant cost and schedule benefit as well as providing for a more uniform application and results.

### 0702 Radiation Sources

*REFER ALSO TO CITATION(S) 7248*

### 0703 Isotopic Power Supplies

7303 (ESA-SP—267, pp vp) **Alternative power supplies for spacecraft.** Harvey, J.M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Thermal-to-electric conversion for high power generation on spacecraft for near Earth applications is considered, because of the potentially higher conversion efficiency of dynamic converters. The main components and their interdependence are identified. Heat could be supplied by concentration of energy from the Sun, from a radio isotope, or from a nuclear source, provided that the heat source temperature can be achieved for the conversion equipment employed. Alternative power sources such as fuel cells are more suited to short term space missions.

### 08 Production

*REFER ALSO TO CITATION(S) 7385, 7385*

## 09 OTHER SYNTHETIC AND NATURAL FUELS

7304 **(AFME—82-0200-1) Technical and economical study of the biomass applications of thermal equipments working with natural gas or domestic fuel oil.** Bourbon, R.; Girardon, M. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 277p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750586/JAW.

This report including two volumes.

A study on the adaptation of existing fuel oil or natural gas thermal equipments to biomass fuels is presented. The considered load range is between 1200 and 12000 thermal kW. Four types of equipment are considered: district heating boilers, industrial boilers, industrial furnaces and industrial dryers. For each type, the technical feasibility of the adaptation and its economical evaluation are presented and compared to the two other scenarios: substitution with a new equipment specially designed for biomass fuel or statu quo.

### 0901 Hydrocarbon Fuels

*REFER ALSO TO CITATION(S) 7221, 7377, 7654*

7305 **(AFME—82-476) Cooperative biogas production.** Cayrol, F. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 143p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750598/JAW.

A study of the feasibility of a cooperative biogas production in France is presented. The objectives were to minimize the constraints for the farmers, to mechanize in a simple manner the supply of agricultural wastes to the facility, to recover the processed residual matter with characteristics as near as possible as those of the initial manure and to dispose them in a conventional system: storage at the edge of the field and usual scattering.

7306 **(AFME—83-0371) Causes of the biological accidents of methane fermentation. Influence of the Rumensin, used in animal feed, in the anaerobic digestion of manures.** Perrier, J.; Jacob, F. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 49p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750590/JAW.

The effects of an antibiotic, the Rumensin, on the anaerobic digestion of manures have been studied. The Rumensin is incorporated to the animal feeding in order to reduce the production of intestinal gases among the ruminants and increase the utilization rate of the ingested food. Rumensin is thus present in the manure. Tests have been conducted with different Rumensin concentration rates and the biogas chemical composition, the volatile fatty acid concentration evolution with time and the viability of the main microbian groups involved in the digestion process are measured and studied.

7307 **(FRNC-R—141) Biogas implementation and utilization.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 322p. (In French). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88750597/JAW.

A review of the technical experience concerning the biogas and its application as a competitor to conventional gaseous fuels is presented. The chemical composition of biogas, its transportation, its purification processes, the thermal properties and utilizations of biogas in motors and burners are successively reported. Regulation and requirement aspects are examined in the last chapter.

7308 **(FRNC-R—159) Manure anaerobic digestion: a guide book for an own construction.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 96p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750589/JAW.

This guide book gives all the information that a farmer needs for the construction on his own of a manure anaerobic digestion system. The selected process, Ducellier-Isman, is characterized by a forced aeration of the manure in order to rapidly accumulate more heat, and by a total immersion of the manure so that the anaerobic conditions are rapidly assured and that the seeding and the medium conditions are homogenized.

7309 **(FRNC-R—167) Production of alternative fuels from biomass.** Carre, J.; Devaux, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 86p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750588/JAW.

The various substrates and feedstocks that can be upgraded to motor fuels are reviewed: production of methanol and ethanol for mixing with gasoline, production of acetone-butanol as solvents for the alcohol-gasoline mixtures, production of vegetable oils as alternatives to fuel oil, production of lean gas and biogas for diesel motors. The different processing technologies are described in their present way or in future applications. The economic analysis of the various processes are also presented together with their industrial, agricultural and social impacts.

7310 **(PB—87-232088/XAB) in vivo and in vitro multinuclear magnetic resonance studies of the energy metabolism of methanogens. Final report, April 1984-April 1986.** Roberts, M.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemistry). Apr 1986. 86p. NTIS, PC A05/MF A01.

See also PB—86-103827.

Methanogens are fastidious anaerobes whose metabolism centers around the reduction of $CO_2$ to $CH_4$, because of their unique biological niche, methanogens possess biosynthetic and energy metabolism pathways that differ from other organisms that fix $CO_2$. The authors have used in vivo and in vitro multinuclear magnetic resonance spectroscopy to monitor energy metabolism, carbon assimilation, and nitrogen flow in Methanobacterium thermoautotrophicum. Specific results include (1) elucidation of a biosynthetic role for 2,3-cyclopyrophosphoglyceric acid, CPP (the major carbon and phosphorus pool in Mb. thermoautotrophicum), in carbohydrate metabolism, (2) evidence for strict metabolic control of CPP biosynthesis and degradation, (3) evidence via analysis of $^{13}C$-$^{13}C$ coupling patterns in cyclopyrophosphoglycerate for the asymmetric condensation of two $CO_2$ molecules to an acetate unit and examination of how several metabolic poisons affect the condensation in vivo.

7311 **(PB—88-101787/XAB) Investigation and optimization of fuel production using dye-based transition-metal complexes as charge-transfer intermediates. Annual report, August 1985-April 1987.** Shelnutt, J.A. (Sandia National Labs., Albuquerque, NM (USA). Process Research Div.). Apr 1987. 74p. NTIS, PC A04/MF A01.

See also report dated Aug 85, PB—86-178993.

Metalloporphyrins have special properties for photosensitizing and catalyzing solar-energy storage reactions. The fundamental understanding of these molecules also provides a unique chemical system for investigating processes controlling desired chemistry. However, the lack of fundamental relationships between reactivity and interactions of these molecules with their environment hampers efforts to design artificial photosynthetic systems. Fundamental spectroscopic studies of metalloporphyrins in fuel-producing environments are being carried out to identify the factors controlling reactivity. The research has shifted from its initial emphasis on hydrogen generation to production of methane. A main aspect involves mimicking biological methanogenesis through investigation of the enzyme, methyl reductase, its nickel-hydrocorphin (a reduced porphyrin) cofactor at the active site, and synthetic analogs of the active site. The enzyme reduces methyl groups derived from carbon dioxide or methanol using reducing equivalents from molecular hydrogen.

## 0902 Alcohol Fuels

*REFER ALSO TO CITATION(S) 7309, 7384, 7386*

7312 **(AFME—82-067) Study of ethanol production in the world with inference of development of an alcohol French motor in tropical zones.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1982. 119p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750593/JAW.

A technical and market research has been conducted in order to evaluate the potential of alcohol motor fuel in the world (sites of production, quantities, grades) and to evaluate the potential market of an alcohol fuel agricultural tractor in the tropical zones. The aim of 5000 tractors per year is reasonable. In the sugar mills environment a four wheel drive 100 hp tractor is the most promising market, while in most Asia and Africa countries a 25 hp tractor would be more adequate.

7313 **(DOE/ER/13625—T1) Model Cu/ZnO catalysts for methanol synthesis: The role of surface structure: Progress report.** Campbell, C.T. (Indiana Univ., Bloomington (USA). Dept. of Chemistry). 1987. Contract FG02-86ER13625. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002354/JAW.

Model catalysts were constructed in order to give insight into the nature of the active sites on Cu/ZnO catalysts. None of these model catalysts (vapor-deposited Cu overlayers on ZnO(0001); Cu(111); Cu(111) with a ZnO/sub x/ monolayer) gave measurable rates of methanol production. The electronic structure of Cu substituted in the bulk and the surface of ZnO(0001) and adsorbed on ZnO(0001) was calculated. Chemisorption of simple molecules important in methanol synthesis on Cu, ZnO, Cu/ZnO clusters was studied with the same (INDO) calculations. The reaction of vapor-deposited Al with Ru(0001) and the interaction of CO with the resulting Al/Ru surface were studied. (DLC)

7314 **(FRNC-TH—2819) Inhibition phenomena and alcoholic fermentation.** Strehaiano, P. (Institut National Polytechnique, 31 - Toulouse (France)). 1984. 222p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750584/JAW.

The dynamic and stoichiometric behaviours of various yeasts have been quantitatively studied in order to demonstrate and quantify the chemical kinetics of the yeast fermentation process, to identify the reaction limiting factors and to unify the behaviour analysis of various yeast phyla. On these observations basis, a fermentation kinetic model has been developed in order to improve the control and the automation of alcoholic fermentations.

7315 **(FRNC-TH—2820) Comparative analysis of fixed bed and entrained processes of biomass gasification: modelling, simulation and prospective economic balances.** Valcov Loureiro, L. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). 1984. 157p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750585/JAW.

Two biomass gasification processes, with fixed bed or entrained bed, are compared. Mixtures of $CO/H_2$ are produced for the synthesis of methanol. Mathematical models describing the beds have been developed in order to evaluate the energy balances and economical balances of the processes. The calculations are done for a wood processed quantity of 100 tons per day. The models are validated by comparing with existent experimental results.

7316 **Laser-initiated chain reactions in the partial oxidation of methane.** Baughcum, S.L.; Oldenborg, C.; Danen, W.C.; Streit, G.E.; Rofer, C.K. (Los Alamos National Lab., Los Alamos, NM 87545). pp 81-89 of Laser applications in chemistry. Evans, D.K. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

Using both thermal initiation and laser photolytic techniques, the authors have been studying important kinetic processes in the partial oxidation of methane. Prompt production of a relatively high concentration of free radicals via laser photolysis makes it possible to separate the thermal initiation step from the subsequent chain propagation steps. If a particular product such as methanol is desired, the conditions (temperature, pressure, and mixture composition) for rapid thermal initiation and optimum yield may differ and laser initiation of the chain provides an exciting potential application for laser-induced chemistry. The authors report their results on the partial oxidation of methane by oxygen at moderate temperatures and pressures. Using 193 nm photolysis of trace amounts of acetone as a source of methyl radicals, dramatic evidence of chain reaction processes is observed for laser initiation under experimental conditions where thermal initiation is not significant. Details of the proposed mechanism are discussed as well as application of the technique to technologies for methane conversion to transportable fuels such as methanol.

### 0904 Solid Waste And Wood Fuels

**7317 (AFME—83-2546) Wood wastes. Granulation-Briquetting. Technico-Economical Evaluation.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 522p. (In French, English and German). NTIS (US Sales Only), PC A22/MF A01. Order Number DE88750595/JAW.

This report is composed of 5 volumes.

The results of a global research on the development of the different wood wastes granulation and briquetting processes are described: review of the press manufacturers in the world, technical evaluation of the commercialized equipments, review of the plants under development or on duty, economic analysis of the financial balance of these plants, calculation of the investment costs, production costs and maintenance costs of the presses and agglomeration devices, economic analysis of the wood wastes processing equipments and of the briquets and granules utilization. Comparisons with other wood waste utilization processes are also presented.

**7318 (DOE/R0/00698—T1) Evaluation of interior Alaska biomass for compressed residential firelogs: Final report.** Sampson, G.R.; Ruppert, F.A. (Forest Service, Portland, OR (USA). Pacific Northwest Forest and Range Experiment Station). 1987. Contract AI51-81RO00698. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87010783/JAW.

Unused tree and moss residue from land clearing operations in Interior Alaska was collected, milled, dried, and densified into fuel logs. Moss and four different tree species were used, resulting in six types of raw materials being sampled. All produced a suitable residential fuel. Logs containing a high proportion of moss were less desirable as a residential fuel because of their high ash content. Heating values of each type of raw material were determined. Practicality of converting the material with high moss content into a densified fuel depends on its long-term storage characteristics. Storage in Fairbanks, Alaska, appears to create a problem because the firelogs tend to break down (decompress) when exposed to the extremes in temperature from winter to summer. Logs showed a tendency to elongate to the point of disintegration. 2 refs., 20 figs., 3 tabs.

## 13 HYDRO ENERGY

### 1306 Environmental Aspects

*REFER ALSO TO CITATION(S) 7883, 7884, 7885, 7886, 7887*

**7319 (TVA/ONRED/AWR—87/33) Improving reservoir releases.** (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Sep 1987. 150p. NTIS, PC A07/MF A01. Order Number DE88900179/JAW.

The TVA is developing and implementing measures to increase minimum flows below selected projects and improve the dissolved oxygen (DO) content of releases from dams where it seasonally declines to low levels. This report describes the latest work undertaken at 20 dams and TVA's Aquatic Research Laboratory (ARL). Criteria for selecting the systems used for DO improvement are low cost and ability to sustain a minimum DO of about 4 mg/L in releases. Also, the techniques must not increase power losses during the times of the year when DO levels are high. Because each project has its own individual characteristics, each selected alternative has been adapted to the conditions that exist at the site.

## 14 SOLAR ENERGY

**7320 (AFME—82-059) Study of the insertion of the renewable energies in the programmes of the French aid to developing countries.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 86p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750601/JAW.

The various aspects and characteristics of the French cooperation programs with the developing countries are summarized and the solar part of the cooperation and its trends are evaluated. Two scenarios of investment assistance evolution in the solar domain are described. The high scenario forecast leads to a twofold increase in ten years with 25 pc for the photovoltaic systems, 50 pc for combustion and gasification of biomass, 25 pc for mini-hydraulic electric plants.

### 1405 Solar Energy Conversion

*REFER ALSO TO CITATION(S) 7305, 7306, 7308, 7309, 7311, 7314, 7315, 7318*

**7321 (AFME—83-4056) Study of the mineral mass and of the fertility conservation in the short and very short rotation cultivations in French Guiana.** Barbier, C. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1986. 92p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750587/JAW.

The effects of short and very short rotation plantations of Eucalyptus urophylla on the soil fertility in french Guiana are presented. Most of the results concern two rotations (main stalk and first shoots) and two different plantation spacings (1m x 1m and 2m x 2m). Three main constituents (N, P, K), three secondary elements (Ca, Mg, Na) and five oligo-elements (B, Fe, Mn, Cu, Zn) were measured in the different parts of the tree (trunk, leaves, branches, bark). The chemical composition is more affected by the localization in the tree than by the spacing.

**7322 (DOE/CH/10198—T1) Artificial photosynthesis using chlorophyll based carotenoid-quinone triads: Final technical progress report.** Gust, D.; Moore, T.A. (Arizona State Univ., Tempe (USA). Dept. of Chemistry). Sep 1987. Contract FG02-84CH10198. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001660/JAW.

Goal of this last year was the synthesis and study of a molecular tetrad consisting of a porphyrin or chlorophyll derivative covalently linked to both a carotenoid polyene and a rigid diquinone moiety. Photosynthesis converts light into chemical potential energy in the form of long-lived charge separation across a bilayer membrane. Recombination of the charge-separated state is prevented by the large distance between the final electron donor and acceptor. Reaction centers employ a series of electron transfer steps, each of which occurs over a short distance with high quantum yield. Synthetic carotenoid-porphyrin-quinone triad molecules and other molecular systems which begin to model this approach have recently been reported by our group and other researchers. In photosynthetic bacteria, the charge separation sequence includes electron donation from a bacteriopheophytin to a quinone which then transfers an electron to a second quinone. The proposed carotenoid-porphyrin-diquinone (C-P-Q-Q) tetrad was designed to model this portion of the natural photosynthetic electron transport system, and to be the next step in the evolution of increasingly complex

synthetic mimics of natural solar energy conversion. Such a tetrad has been prepared. Nanosecond laser flash photolysis and picosecond fluorescence decay studies were carried out. Electron transfer reactions in C-P dyads and C-P-Q triads were studied.

7323 **(ESA-SP—267) Proceedings of the fifth European symposium on photovoltaic generators in space.** Burke, W.R. (European Space Agency, 75 - Paris (France)). Nov 1986. 486p. (ETN—87-90157; CONF-8609216—). NTIS, PC A21/MF A01.

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Some areas of discussion at the symposium are solar cell technology, module technology, solar arrays, environmental interaction, in-flight performance,and alternative power generation. Also, cell assembly technology, solar array analytical modeling, and tests and measurements were discussed.

7324 (ESA-SP—267, pp vp) **Experience in manufacturing GaAs space solar cells.** Iles, P.A.; Yeh, Y.C.M.; Ho, F.H.; Chang, K.I. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Experience acquired in establishing a manufacturing process for GaAs solar cells for use on spacecraft is summarized. Process selection, the build-up of equipment and material support, and the results achieved are described.

7325 (ESA-SP—267, pp vp) **Manufacturing status of GaAs solar cells for space applications.** Matsuda, S.; Shirata, K.; Kawakami, A.; Yoshida, S.; Otoda, M.; Hokuyo, S. (Mitsubishi Electric Corp., Hyogo, Japan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Around 50,000 GaAs solar cells per year with typical efficiency of 17.5% are routinely produced by liquid phase epitaxy (LPE) using the vertically separated three chambers technique. The cells will be used in space solar array for Japanese domestic communications satellite (CS-3) to be launched in 1988. The LPE process and in-line process control used to achieve the required quality in a GaAs solar cell are described. The mass production process data is also presented and the future technology of GaAs solar cells is discussed.

7326 (ESA-SP—267, pp vp) **Gallium arsenide solar cell development.** Burrage, J.; Cross, T.C.; Holtom, R.; Richards, P.M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Reasons for choosing GaAs solar cells are outlined. Flat panel and concentrator GaAs solar cells are considered together with the manufacturing methods employed. Substrate processing methods using metallo-organic chemical vapor deposition and infinite melt liquid phase epitaxy techniques are described together with the special attention required of contacting methods to achieve successful front and rear electrical contacts. The important features of a GaAs solar cell manufacturing facility are reviewed.

7327 (ESA-SP—267, pp vp) **Assessment and improvement of the GaAs solar cell technology for a production pilot line.** Bertotti, L.; Flores, C.; Paletta, F.; Marchetti, P.; Martella, M. (Fabrica Italiana Apparecchi Radio S.p.A., Milan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A research program to set up a pilot line to produce GaAs solar cells by liquid phase epitaxy for space applications is reviewed. Laboratory production was analyzed to assess its maturity. A sample of 200 cells with area of 2x2 cm and 2x4 cm was produced; electrical characterization as well as environmental tests were carried out. Efficiencies of 17.5% at 1 Sun and AMO spectral distribution are obtained on CIC cells. A qualification test plan, specific for space GaAs solar cells, was proposed. Results on temperature coefficient dependence on 1 MeV electron fluence are shown.

7328 (ESA-SP—267, pp vp) **New aspects of the system silicon/contact/interconnector.** Schilling, R.; Strobl, G.; Rasch, K.D. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

To avoid solar cell and contact modifications by welding of the interconnector onto the cell, a homogeneous system interconnector and contact (Intercontact) was developed. Contact and interconnector are formed simultaneously during solar cell metallization. Intercontact is flexible and can be formed by adequate tools to each desired form, e.g., with a loop for an out-of-plane configuration. Intercontact has the normal metallization thickness (10 microns). The thickness can be increased by galvanic Ag deposition. The evaporation process allows different Intercontact design and structures on front and rear side of the cell. Advantages include weight saving, reduced assembly costs, improved thermal cycling behavior, potential of wrap around, and implementation for similar devices. Cells with Intercontact meet standard cell requirements. Test results show satisfactory characteristics before and after thermal cycling.

7329 (ESA-SP—267, pp vp) **Investigations on ultrasonic welding for silicon solar cells used for space.** Hoffmann, U.; Snakker, W.; Soll, J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Silicon solar cells with aluminum and silver contacts were welded to 11 different interconnector materials by a piezoelectric weld equipment with 3 sonotrode configurations. It is concluded that the selected materials with the used weld equipment parameter sets can be successfully ultrasonically interconnected. The parameter limits are not known because the real end of life performance and degradation rate of the weld spot was not predicted. The 2300 thermal cycles between plus 130 and minus 150 C (assumed metallurgical fatigue acceleration factor 10) indicate pull force degradations of 30 percent for Al Si 11.7 interconnector (button out effect) and 15 percent for MoAg-interconnector both on Ag-cell contacts.

7330 (ESA-SP—267, pp vp) **AMOC: an alternative module configuration for advanced solar arrays in low Earth orbits.** Koch, J.W. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A module concept, based on bifacial Si-solar cells, which also convert Earth albedo radiation to obtain an additional power gain was developed. Tests comprising 15,000 LEO-thermal cycles of real modules, irradiation tests, static load tests, and vibration tests with a fold stack in 2 configurations were conducted. The results show that the chosen design (bifacial cell, transparent substrate, long life interconnector) can meet LEO-mission requirements for extended lifetime.

7331 (ESA-SP—267, pp vp) **Low Cycle Fatigue (LCF) of solar cell welding joints made of silver.** Reul, S. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

To improve solar cell modules for low Earth orbit missions of greater than 10 yr, low cycle fatigue investigations on silver interconnectors welded on silverized silicon solar cells were conducted. Experiments on 20 and 35 micron thick Ag-foil interconnectors at reduced welding temperatures, up to 18,000 thermal cycles + or - 100 C; simulation of mechanical loads in welds caused by thermal cycling using the finite element method; investigations at optimized welding temperatures up to 30,000 thermal cycles; and testing of optimized solar cell modules up to 60,000 thermal cycles are summarized.

7332 (ESA-SP—267, pp vp) **Finite element simulation model and a temperature measurement for the solar cell welding process.** Reul, S. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The parallel gap welding process was simulated by the finite element package ASKA. The welding calculations were performed by nonlinear, electric-thermal coupled stationary and dynamic two dimensional control programs. An infrared temperature sensor which measures the mean temperature of the interface contact/solar cell was developed. The measured temperatures during quasi-static weldings were used for calibration of the stationary calculations. Welding voltages and solar cell thicknesses were varied. A transient calculation was correlated to a measured example.

7333 (ESA-SP—267, pp vp) **Direct glassing of solar cells.** White, P.A.; Dollery, A.A.; Davies, R.T.; Read, M. (Royal Aircraft Establishment, Farnborough, England). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A method of bonding a coverglass to the solar cell is described. An electrostatic process is used which results in a chemical, anodic bond at the interface. This bonding process is permanent and does not degrade the solar cell. The process eliminates the adhesive layer. To obtain a directly glassed solar cell, it is essential that the coverglass possesses the same thermal expansion coefficient as the silicon. Thus the use of a coverglass, designated CMZ, is a bonding process requirement. The advantages of a directly glassed solar cell include reduced array mass, reduced procurement costs, and reduced integration costs. The elimination of the coverglass adhesive reduces array outgassing and ensures cleaner spacecraft.

7334 (ESA-SP—267, pp vp) **High performance solar array GSR3.** Mamode, A.; Bartevian, J.; Bastard, J.L.; Auffray, P.; Plagne, A. (Societe Nationale Industrielle Aerospatiale, Les Mureaux, France). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A fold out solar array with carbon-frame panel structure and stirrup-fastening peripheral hold-down concept for communication satellites in multiple payload launches was developed. Over 35W/kg end of life is achieved by using BSR 180 micron classic solar cells. Computation shows that the 50W/kg line can be surpassed with 50 micron BSFR solar cells. Modularity and versatility as well as expected performances suggest an extension to domains such as low-orbit missions, space stations, and retractable solar arrays.

7335 (ESA-SP—267, pp vp) **EURECA application of the retractable advanced rigid array (RARA) solar array.** Dekam, J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A reusable, retractable solar array for low Earth orbit free flyers was designed. The design can be applied for power up to 10 kW, but can be extended. The rigid concept allows for a simple and therefore reliable and cost effective design. A high design flexibility with respect to wing lay out and interface is featured. It will be applied on EURECA in a 5 kW version.

7336 (ESA-SP—267, pp vp) **Improved solar generator technology for the EURECA low Earth orbit.** Gerlach, L. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The design and related activities of the electrical part of the EURECA solar array based on the shadow protection requirement and the extreme environment due to the atomic oxygen effects in the EURECA low Earth orbit combined with a high (20,000) number of thermal cycles are discussed. Tradeoff studies for the solar cell selection determined the optimum cell type in respect to power to mass ratio and cost effectiveness. The verification program is summarized and the solar cell technology to be applied for low Earth orbit missions with extended mission life (10 yr) equivalent to 60,000 thermal cycles is identificd

7337 (ESA-SP—267, pp vp) **INMARSAT solar array: the first advanced rigid array (ARA) to fly.** Zijdemans, PH.J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Design and verification of a project solar array from a generic concept are described. Part level and wing level testing prove that the rigid design option yields a viable and promising solar array family, capable of delivering 30 to 40 W/kg, 10 yr end of life, within the range of application of 1 to 4 kW.

7338 (ESA-SP—267, pp vp) **High power solar array technologies.** Behrens, G. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Potential high power solar arrays for the Columbus program were investigated with regard to critical technologies needed for their electrical parts. The investigations and assessments for definition of technology items where specific problems exist and further work is necessary are described. Main problem areas are the harness concept, manufacturing, and high voltage and environmental aspects.

7339 (ESA-SP—267, pp vp) **GaAs concentrator solar arrays.** Harvey, J.M.; Howard, J.; Haywood, D. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The planar trough concentrators (PTC) for the Olympus and Cassegrain concentrators for the Columbus solar arrays were compared. The study of the PTC shows that it is a feasible concept, retaining the major configuration of a planar array. The PTC gives a 10 percent mass saving, and 40 percent area reduction, over a GaAs planar as well as a 40 percent reduction in quantity of cells required. These savings of mass, area, and cell costs make the GaAs PTC a worthwhile contender for geostationary satellites. Although the Cassegrain concentrator appears disadvantageous against planar GaAs in terms of mass and area, the saving in cells of 75 percent and in bulk cell material of 98.5 percent gives the Cassegrain a large cost advantage. The large number of 2 x 2 cm GaAs cells required is considered beyond present supply capability for the planar solution. Therefore the Cassegrain concentrator is advantageous for large LEO spacecraft.

7340 (ESA-SP—267, pp vp) **Gallium arsenide or silicon array for near future?.** Pelenc, L. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Cost and technical data of silicon and gallium arsenide spacecraft solar arrays are compared. Technically, gallium arsenide is competitive at silicon solar array subsystems level for flux solar arrays. Configurations which require a high surface power are sometimes not feasible with silicon (spinned satellites, stowed transfer or hot cases, concentration).

7341 (ESA-SP—267, pp vp) **Fokker strongback solar array.** Zwanenburg, R. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The strongback solar array with rigid solar panels offers a design solution for power levels up to 40 kW. The strongback array deploys the panels simultaneously in a synchronized way. The deployment is actuated by deployment springs. Deployment control and retraction is possible. High strength and stiffness in deployed condition is obtained by the preloaded truss-type structure. A life size model of 9 m length demonstrates the performances.

7342 (ESA-SP—267, pp vp) **Micrometeorite impact on solar panels.** Schneider, E. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A micrometeorite simulation program studied damage phenomena and failure mechanisms of solar panels under hypervelocity impact conditions, to see if space debris and micrometeorites cause short circuits in solar arrays, e.g., of MARECS-A satellite. Experiments demonstrate that transient and permanent short circuits can be produced by particle impact. Arc discharges can be initiated under realistic electrical power conditions. There is evidence that failures caused by impact induced short circuits can be minimized by improving the geometrical arrangement of the panels and by optimizing the electrical circuitry.

7343 (ESA-SP—267, pp vp) **Micrometeorite exposure of solar arrays.** Weishaupt, U.; Kuczera, H.; Rott, M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Permanent losses of a part of the available power on solar arrays of ESA satellites, possibly caused by micrometeoroid or space debris impacts were studied in hypervelocity impact simulations at a plasma accelerator using ECS and Olympus solar panel structures. Results confirm that significant damage of the solar arrays can be caused by small hypervelocity particles. Using a solar array simulator connected to the test sample, penetration phenomena and arc triggering effects were investigated within the efficiency range of the accelerator. Temporary or permanent short circuits between the solar cells and the panel structure may lead to a loss of solar array power and additional damage may be created if arcing occurs.

7344 (ESA-SP—267, pp vp) **Anomalies observed in plasma-module-interaction experiments.** Thiemann, H.; Dharmarao, P.V. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Plasma-module-interaction experiments in a simulated low Earth orbit plasma were conducted. Local ionization of the neutral background gas appears to result in a very efficient plasma shielding of the biased interconnectors with small sheath dimensions. The discharging processes on the dielectric solar cell cover glass surfaces therefore are not influenced by the strong electric field near the interconnectors. Only for sufficiently large module voltages (typically 200 V) the plasma sheath reaches the dielectric parts and the processes around the various parts of the module mutually interact, causing anomalies in the interaction.

7345 (ESA-SP—267, pp vp) **Stopping differential charging of solar arrays.** Lechte, H.G. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Assuming that the build up of electrostatic charge on solar arrays of geostationary satellites is a contributing factor in reducing the lifetime of insulators, the mechanism of charging the elements of a rigid solar array was analyzed and means to reduce differential charging proposed. These include avoidance of charging the array rear, a better matching of secondary emission yields between both faces of the array, and the provision of an electrical leakage path between cover slips and solar cells to bleed off any charge. It is advised that the design of solar generators for geostationary missions takes seriously into account the build up of electrostatics and provides for sufficient precautions against resulting stresses, including those from micrometeorites.

7346 (ESA-SP—267, pp vp) **Advanced solar GaAs array (ASGA) experiment on EURECA: flight objectives and instrument configuration.** Bertotti, L.; Flores, C.; Paletta, F.; Zuliani, L. (Consiglio Nazionale delle Ricerche, Rome, Italy). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The Advanced Solar GaAs Array (ASGA) experiment consists of a solar panel with different GaAs solar cells to be flown by EURECA-1. During the whole mission electrical and thermal data relevant to different strings of cells are automatically recorded by dedicated electronics to check the performance trend of GaAs solar cells when exposed to the low Earth orbit environment. The EURECA flight gives an opportunity to evaluate the properties of standard and advanced GaAs solar cells over a period of 6 months. The EURECA environment (the same as that for the future space station) is characterized by: high number of eclipses, low radiation density, and atomic oxygen erosion. The ASGA experiment tests the effects of these physical aspects on different kind of cells. On the solar panel, concentrator and planar cells will be mounted.

7347 (ESA-SP—267, pp vp) **SPOT solar array in-orbit deployment results evaluation.** Bobo, PH. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The design and deployment sequence of the SPOT satellite flexible solar array are recalled. The analysis tools whereby in-orbit behavior can be retrieved are described. Results from telemetry deliveries are presented and evaluated to derive solar generator flight data. Performances are compared to predictions or simulations. The performance budget shows good performance-prediction correlation, increasing confidence level for this solar array subsystem, three specimens of which are in production.

7348 (ESA-SP—267, pp vp) **Electrical performance comparison BSFR-/bifacial solar cell array.** Hoffmann, U.; Reissmann, F. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Conventional and bifacial solar arrays were compared on subsystem level using the Space Telescope-solar array mission as reference. Calculations show that the bifacial solar cell has a performance advantage of 18 to 21 percent. This is due to a 5°C average lower temperature of the bifacial cell at the same orbit conditions; the rearside albedo irradiation of 86 to 170 W/sqm (average of 180 deg and 0 deg orbit orientation respectively); and the fact that the temperature difference between the hot case (satellite between Earth and Sun) and the cold case (before eclipse) is lower for the bifacial cell than for the BSFR cell. This lower difference has the advantage that the operation point for the bifacial cells is closer to maximum voltage point over the orbit. Resistivity of the bifacial solar cells against particle radiation, and absorptivity of front and rearside of the bifacial cell for infrared radiation must be verified. Statistical deviations of the albedo intensity and spectrum are not known.

7349 (ESA-SP—267, pp vp) **Aerospatiale solar arrays, in orbit performance.** Juillet, J.J.; Samson, P.; Pelenc, L.; Heeschen, G.; Dettlaff, K. (AEG-Telefunken, Wedel, West Germany). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Correlation between on-ground prediction and in-orbit mechanical and electrical behavior for Telecom-1, ARABSAT, and SPOT solar arrays is shown. When recorded during the deployment phases, the current growth curves allow a good correlation between mechanical models and flight data. Flight data and the performance predictions are well correlated, within the measurement and model accuracies after adjustment of the cell data with ground flasher test results. For geostationary (GEO) missions, transfer orbit degradation may be due to an equivalent radiation dosage lower than usually computed (5 El3 e/sq cm). If so, mismatch and calibration losses may be neglected at BOL, for a nominal power output prediction, this being confirmed by SPOT 1 data analysis. Solar cell degradation due to radiation as observed at the beginning of missions seems to be compatible with an annual equivalent radiation dosage of 5 El3 e/sq cm for GEO missions, and very low for low orbits.

7350 (ESA-SP—267, pp vp) **Fifty micron thin solar cell assembly and environmental tests.** Hashimoto, H.; Aoki, Y.; Iwakami, M.; Nishiyama, H. (Toshiba Research and Development Center, Kawasaki, Japan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

A solar panel assembly study was conducted to establish a way to incorporate ultrathin silicon cells (BSFR) into solar arrays. Parallel gap welding (PGW) and improved solder welding (ISW) were introduced to interconnect the cells, and quality controls through the manufacturing process were implemented. Both methods were evaluated by comparing the results from thermal cycle, thermal vacuum, vibration, shock, and acoustic tests on lightweight lattice panels and semirigid panels. No weld joint failures or electrical degradation are observed. Results indicate the suitability of PGW and ISW for ultrathin solar cells. The validity of assembly and accommodation techniques to the substrate is also confirmed. The assembly technology will be applied to the Japanese Earth Resources Satellite and Engineering Test Satellite.

7351 (ESA-SP—267, pp vp) **Thin single-crystalline silicon solar cells for space applications.** Nijs, J.; Caymax, M.; Acke, P.; Roggen, J.; Lambrechts, M.; Gravesen, P. (Technical Univ. of Denmark, Lyngby). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

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A technology to perform etching after the formation of the solar cell, using epitaxial deposition of the active layer of the cell combined with an etch stop technique is proposed. This can result in highly efficient silicon solar cells with thicknesses down to 10 microns.

7352 (ESA-SP—267, pp vp) **Status and prospects of indium phosphide based solar cells for space use.** Pearsall, N.M.; Hill, R.; Dollery, A.A. (Royal Aircraft Establishment, Farnborough, England). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The state-of-the-art of InP solar cells is reviewed. Cells of area up to 8 sq cm with AMO efficiencies of 18 percent are achievable. Experiments indicate that the radiation resistance of InP cells is extremely good, due to photoenhanced room temperature annealing of radiation damage. Calculations of the power/mass ratio of arrays of Si, GaAs, and InP cells show that 2 x 2 cm InP cells with an efficiency achieved on 0.8 sq cm cells compare well with commercially available Si and GaAs cells. Engineering development of InP cells should result in a significantly superior performance compared to Si and GaAs cells. The potential superiority of the InP cells is such that the use of InP cells in a satellite array could have significant economic advantages in spite of the higher materials cost of the InP compared to GaAs.

7353 (ESA-SP—267, pp vp) **State-of-the art of solar cell welding technology at ISRO: experiences and future plans.** Srinivasamurthy, N.; Sudhakar, M.; Sharma, S.K.; Agrawal, B.L. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

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Progress in solar cell welding technology and facilities are presented. Problems relating to fabrication and quality control are discussed.

7354 (ESA-SP—267, pp vp) **New generation of coverglasses.** Kitchen, C.A.; White, P.A.; Dollery, A.A.; Yale, B.; Fyles, K.M. (Pilkington P.E. Ltd., Lathom, England). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Solar cell coverglasses, named CMZ, which possess all the properties of the existing range, but with a thermal expansion coefficient which matches that of silicon over a wide temperature range, were developed. This has the advantage of maintaining optical efficiency while minimizing the interface stresses between the solar cell and coverglass as the temperature of the array varies with orbital position. The matched thermal expansion coefficient makes possible the application of coverglass integration techniques other than the conventional use of silicone adhesives, e.g., electrostatic bonding, Teflon bonding, rigid adhesive, and encapsulation, and also large area coverglasses uses as superstrates.

7355 (ESA-SP—267, pp vp) **Improved performance solar cell coverglasses and second surface mirrors.** Whalley, A.M.; Jones, D.P.; Mullaney, K. (Pilkington P.E. Ltd., St. Asaph, Wales). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Coatings for solar cell coverglasses and second surface mirrors (SSM) for satellite thermal control were developed to provide improved thermo-optical properties compared with existing products. The first coating has an enhanced infrared emittance. Use can boost the emittance for uncoated or visible antireflection coated CMX by at least 4 percent. This means that the coverglass and SSM can radiate heat more efficiently hence reducing the temperature of the solar cell and the satellite body respectively. The second coating has reduced solar absorptance. Theoretically the value can be decreased by 0.04 using this coating. This reduction means that the heating effect of the Sun on the coverglass or SSM itself, will not be so great and a lower temperature may be maintained.

7356 (ESA-SP—267, pp vp) **Bifacial silicon solar cells in space: antireflection (AR) coatings and thermal behavior.** Correig, X.; Calderer, J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

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An approach to antireflection coating (ARC) design which recognizes that bifacial silicon solar cell efficiency is related to antireflection coating design and operating temperature by optical, electrical, and thermal behavior of the structure, is proposed. Maximum efficiency coincides neither with minimum temperature nor maximum absorptance. A compromise among these variables can be reached. Calculations make it possible to design ARC to reach an absorptance value near 0.6. Calculations of back side reflectance show that reflectance of isotropic incident light is larger than that of normal incident. Efficiency values are much less affected by ARC thickness. Mass budgets of bifacial arrays are similar to those of monofacial ones, so the only difference in thermal cycle amplitude is due to differences in operating temperature.

7357 (ESA-SP—267, pp vp) **Connector integrated thin silicon solar cells attached interconnectors by alternating current welding machine.** Matsutani, T.; Saga, T.; Kaminishi, S.; Ogura, M.; Hagihara, Y.; Hirano, T.; Suzuki, A.; Ushirokawa, A. (Tokyo Univ., Japan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Connector Integrated Cells (CIC's) with photoetched silver mesh interconnectors were developed to achieve easy handling of thin silicon solar cells. Interconnectors with in-plane stress relief were chosen because they do not protrude from top surfaces of CIC's. The fatigue life of interconnectors with in-plane stress relief meets the requirement for 10 yr in geostationary orbit, assuming that CIC's are laid down on an aluminum honeycomb substrate. Silver needs more welding current than other materials to obtain sufficient welding strength due to its lower resistivity. Direct current welding machines take too long to charge their batteries. To increase the throughput of welding process, an ac welding machine which does not need charging time at all was introduced. The CIC's are qualified by the Japanese Institute of Space and Astronautical Science (ISAS) and NASDA; ISAS decided to employ CIC's for the solar array of the EXOS-D satellite.

7358 (ESA-SP—267, pp vp) **UV cut performance of coverglasses for solar cells of satellites.** Matsuda, S.; Kimura, T.; Haruyama, K.; Kijima, T.; Moriguchi, Y.; Tamamura, R. (Asahi Shimbun Co., Japan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

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An equation for determining the ultraviolet cut-on wavelength from the glass thickness and $CeO_2$ concentration for a cover glass composed of soda-lime-based glass doped with $CeO_2$, and the practical cut-on wavelength, determined by ultraviolet irradiation testing, which prevents damage to the adhesive by ultraviolet rays, is presented. Calculations show that the practical ultraviolet cut-on wavelength value is 346 nm, which can be obtained with a 100 micron thick glass doped with a $CeO_2$ concentration of 3 percent. The same cut-on wavelength can be obtained from a thickness of 50 microns with a $CeO_2$ concentration of 5 percent, or a thickness of 150 microns with a $CeO_2$ concentration of 1.5 percent.

7359 (ESA-SP—267, pp vp) **Analysis of low energy proton GaAs solar cell degradation.** Garciamoreno, E.; Prat, L.; Alcubilla, R.; Castaner, L.; Correig, X. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Theoretical models were developed and implemented as software tools to calculate radiation induced degradation of GaAs solar cells in proton environments. Photovoltaic characteristics parameters are calculated after defect induced profile determination following a proton exposure, both isotropic and normally directed to the cell surface. Results include the estimation of the effect that range straggling may have in the overall photovoltaic response. The results are compared with experimental data to assess the validity of the model and assumptions. The damage coefficient relative to 10MeV protons shows a maximum at 150KeV for the geometry considered.

7360 (ESA-SP—267, pp vp) **Thermal-electrical dynamical simulation of spacecraft solar array.** Reticcioli, M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

An approach to model, in an electrical analogy, a spacecraft solar array in the space environment during operating life is outlined. Thermal and electrical coupling effects are dynamically taken into account, so that the thermal and electrical behavior during spacecraft transient events can be simulated. The model takes into account other factors affecting the output power, such as illumination, environmental conditions, and seasonal and aging factors. Since the model is defined in terms of equivalent electrical circuits a general purpose circuit simulation program, such as SPICE, can be utilized. Results of simulations are reported.

7361 (ESA-SP—267, pp vp) **METEOSAT solar array.** Schmidt-Zurborg, J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The design of the electrical part of the Meteosat solar array is presented. Layout, connections, wiring, solar cell assembly, and interface between electrical part and mechanical part are described. The basis of the power calculation is mentioned and aspects of the power output as the power ripple are explained. The qualification test program is listed and test results are reported.

7362 (ESA-SP—267, pp vp) **Design and fabrication of Stretched Rohini Satellite-1 solar array.** Srinivasamurthy, N.; Sudhakar, M.; Agrawal, B.L.; Gopalan, A.U. (Indian Space Research Organization, Trivandrum). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The SROSS satellites solar array studies and selected configuration are described. Mission demands are such that spinning and three axis stabilized satellites are required. A single bus satellite design catering to both types of mission requirements was envolved, imposing severe constraints on the solar array design. The satellite structure is an octagonal cylinder. The eight deployed panels are stowed against the corresponding body mounted fixed panels. The deployed panels contain cell on both sides and each deployed panel makes an angle of 135 deg with the corresponding body mounted panel when deployed. A modification in this configuration is to distribute the deployable panels on each end of the octagon. The SROSS satellites require 96 W raw power for 3 axis stabilized versions, 66 W for spinners.

7363 (ESA-SP—267, pp vp) **Theoretical quantification of nonlinear effects in silicon solar cells.** Ruiz, J.M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

An analytic model for the internal quantum efficiency of solar cells is presented. It is especially intended for explanation and quantitative analysis of nonlinear effects in silicon solar cells. The model differs from conventional ones in that it considers trap-filling as well as ohmic electric field effects on carrier recombination. The responsibility of both effects for quantum efficiency enhancement (superlinearity) are analyzed. The field effect is found to be the only one having influence at the irradiance ranges usual in spectral response measurements. Very simple formulas accounting for nonlinear effects are obtained. Quantitative results for a typical 10 Ohm cm p-type base silicon solar cell are presented.

7364 (ESA-SP—267, pp vp) **Modeling bifacial silicon solar cells for space degradation prediction.** Prat, L.; Garciamoreno, E.; Alcubilla, R.; Castaner, L.; Ruiz, J.M. (Universidad Politecnica de Madrid, Spain). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Silicon bifacial light sensitive solar cells were modeled by a calculation of the profile of induced defects after irradiation, and by the transport equations solution through the cell structure with the appropriate boundary conditions. Results show that the bifacial benefits are lost after a flow of 1 MeV electrons or 10 MeV protons. The effect of proton energy was analyzed and a maximum of degradation is found. Back surface proton irradiation damages first the high-low back junction.

7365 (ESA-SP—267, pp vp) **Test results from the solar array flight experiment.** Turner, G.F.; Menning, M.D. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The Solar Array Flight Experiment flown on STS-41D demonstrated the readiness of this technology and associated analytical tools to support advanced programs such as Space Station. The solar array, which measured 4.5 x 31.5 m, was successfully deployed and retracted several times during the mission, and electrical, mechanical, and dynamic performance was observed and measured, with excellent correlation with preflight predictions.

7366 (ESA-SP—267, pp vp) **Solar array plasma interaction experiment (SPIE). Bifacial cell technology calibration (BCC). Planned in orbit experiments.** Bebermeier, H. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

An experiment for a flight verification of high voltage solar arrays is proposed. The configuration can also be used with an optical sensor system for the measurement of the albedo flux. Exact albedo values are required for bifacial solar array technology.

7367 (ESA-SP—267, pp vp) **Spectral response measurements of silicon solar cells for space qualification.** Carabe, J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The theoretical basis of solar cell spectral response measurement is presented to check the validity of the approximations which have to be done and to analyze a set of error sources which must be taken into account in order to obtain reliable results. Tests using a pulsed light source facility are described. Three cells were tested with two different flash units at several irradiance levels. One cell was a BSF one in order to check whether spectral responsivities of this kind of cell can be satisfactorily measured with pulsed light sources. Further investigations are needed to get a more complete understanding of cell linearity for selected wavelengths and the mechanisms involved in it, and to check if the errors found are inherent to the pulsed nature of the light used.

7368 (ESA-SP—267, pp vp) **Absolute indoor calibration of large area solar cells.** Metzdorf, J.; Wittchen, T.; Kaase, H. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Equipment for the calibration of reference solar cells which is traceable back to their primary radiometric standards is presented. The apparatus, based on the differential spectral responsivity method is an absolute indoor procedure without reference solar cells, and needs no solar simulator. The method is applicable to all kinds of test devices up to solar cell areas of 10 x 10 cm without any requirements on linearity and spectral responsivity of the cells.

7369 (ESA-SP—267, pp vp) **Very low temperature rise laser annealing of radiation damaged solar cells in-orbit.** Poulek, V. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Very low temperature rise (less than 1 C) laser annealing of radiation damaged photovoltaic cells was demonstrated using a GaAlAs diode laser. Low dose radiation damage can be annealed without thermal effects. Photon induced recombination enhanced injection annealing could be the reason. Due to very low temperature rise no laser induced damage of the solar cells nor damage of the complete solar panel is possible.

7370 (ESA-SP—267, pp vp) **Test equipment for reverse and forward characteristics.** Samson, P.; Dides, C.; Laugeri, J. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The main requirements and performance characteristics of a laboratory device to measure the current-voltage characteristics of solar cells over a wide range of temperatures are described. It includes 1 solar constant 1 AMO simulated flux provided by a xenon lamp arc; light chopper system (2 linear blades) LN2 gas test chamber; temperature range minus 150 to plus 150 C; and thermally instrumented and controlled support for solar cells restrained in vertical position by a depressure system. No more than 8 solar cell assemblies are tested in a run.

7371 (ESA-SP—267, pp vp) **Radiation damage in proton irradiated indium phosphide solar cells.** Weinberg, I.; Swartz, C.K.; Hart, R.E. Jr.; Yamaguchi, M. (Nippon Telegraph and Telephone Public Corp., Tokai, Japan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Indium phosphide solar cells exposed to 10 MeV proton irradiations were found to have significantly greater radiation resistance than either GaAs or Si. Performance predictions were obtained for two proton dominated orbits and one in which both protons and electrons were significant cell degradation factors. Array specific power was calculated using lightweight blanket technology, a SEP array structure, and projected cell efficiencies. Results indicate that arrays using fully developed InP cells should out-perform those using GaAs or Si in orbits where radiation is a significant cell degradation factor.

7372 (ESA-SP—267, pp vp) **Mismatch corrections of solar cell spectral response measurements with a reference cell.** Ruiz, J.M.; Cid, M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Spectral response measurements using a reference cell of calibrated spectral response and a set of narrow band interference filters are shown to suffer from an inherent error, coming from the unavoidable finite bandwidth of interference filters. The so-called spectral response mismatch error is analyzed and quantified. A simplified procedure for first order analysis, and more complete one for practical correction of spectral response measurements are outlined. The usefullness of the procedure to indirectly perform real time checks of measurement setups is discussed. Results from routine measurements performed on different technology cells with the same reference cell are presented.

7373 (ESA-SP—267, pp vp) **Energy dependence of proton irradiation damage in GaAs solar cells and effects of combined radiation on them.** Takata, N.; Matsuda, S.; Gomi, J.; Toriyama, K.; Goto, M.; Hokuyo, S. (Mitsubishi Electric Corp., Kamakura, Japan). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Energy dependence of proton irradiation damage was obtained by exposing GaAs solar cells to protons over the energy range of 0.05 to 15 MeV. Relative damage coefficients are shown as a function of proton energy and fluence. Effects of combined radiation on GaAs solar cells are discussed; the degradation characteristics of GaAs solar cells exposed to protons with different energy or electrons in addition to protons are evaluated through degradation calculations. A method considered to be more useful for estimating degradation of solar cells by combined radiation than the conventional one is described.

7374 (ESA-SP—267, pp vp) **Radiation damage in GaAs and ultrathin Si solar cells due to low energy electrons.** Matsuda, S.; Tsuji, M.; Mitsui, H.; Tanaka, R.; Sunaga, H. (Japan Atomic Energy Research Institute, Takasaki). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Gallium arsenide (280 microns) and ultrathin Si (50 microns) solar cells were irradiated with electrons over the energy range 0.3 to 3.0 MeV. The relative damage coefficients for normal incident 0.92 MeV electron on bare cell were derived. This result shows shield effects of coverglass at low energy. Solar cells were exposed to Co-60 gamma rays to obtain the relation between gamma ray dose D and electron fluence phi, assuming phi = aD sup b. Results show that coefficient a depends on the electron energy and b is nearly equal to 1.

7375 (ESA-SP—267, pp vp) **Setting-up of SPASOLAB.** Sanchez, E.; Gras, A.M. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Solar simulator, spectral response, and data acquisition requirements and equipment for a solar cell test and qualification facility are described.

7376 (ESA-STM—238) **Hubble Space Telescope solar array: a thermally induced disturbance torque.** Poelaert, D.; Burke, W.R. (European Space Research and Technology Centre, Noordwijk (Netherlands)). Mar 1987. 25p. (ETN—87-90482). NTIS, PC A02/MF A01.

The thermoelastic behavior of one solar array wing of the Hubble Space Telescope (HST) as it enters sunlight (or eclipse) was investigated by taking a simplified model of the blanket longitudinal elasticity and a Coulomb friction model within the drum bearings at one end and within the spreader bar compensator mechanism at the other end of the blanket. A temperature increase (or decrease) linear in time was assumed for the blankets. The interaction torque between one wing and the HST body was assessed to evaluate the impact of array thermoelastic motions on HST pointing. Dynamic simulations were performed for different combinations of friction coefficients within the drum and spreader bars. The equations of motion are derived from a Lagrangian analysis, where the blankets are represented by a continuum. The behavior of the moving parts of the array and the interaction torque are shown.

7377 **(EUR—9826) Production of renewable hydrocarbons through the culture of green unicellular alga Botryococcus: Study of the factors affecting the production of hydrocarbons: Final report.** Casadevall, E.; Bailliez, C.; Berkaloff, C.; Brenckmann, F.; Chirac, C.; Corre, B.; Coute, A.; dif, D.; Largeau, C.; Metzger, P. (Ecole Nationale Superieure de Chimie, 75 - Paris (France)). 1985. 65p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900122/JAW.

The green unicellular alga Botryococcus braunii with a hydrocarbon content as large as 75% of the dry weight holds a good place among energy-rich biomass. Cultivation of this alga would afford a direct and renewable source of solar fuel. The possibilities of an industrial production of hydrocarbons by large scale cultivation of Botryococcus is addressed. These studies sought to determine the optimum conditions for cultivation of this organism at a pilot scale. Basic studies on morphology and metabolism of Botryococcus were accomplished along with preliminary research on the parameters of its culture. Our main results show exocellular localization of hydrocarbons, possible selection of very productive strains, high hydrocarbon production during active stage of growth, and substantial improvements of productivity by variation of culture conditions. Large scale cultivation of Botryococcus for industrial production of hydrocarbons can be realized. 38 refs., 17 figs., 27 tabs.

7378 **(EUR—9863) Improvement of forest trees for short-term biomass production.** Teissier du Cros, E. (Commission of the European Communities, Luxembourg). 1985. 47p. (In French). Commission of the European Communities, Luxembourg.

This programme aims at selecting and improving highly productive forest tree species for short term biomass production. Sites where this forest biomass production could be established appear marginal for high quality forest production. The programme has to be developed in the following directions: increasing the number of genera to be tested, wider sampling of the potential biomass production areas in France on which to establish trials, more accurate study of the alder-Frankia symbiosis to produce a fast adaptation and quick early growth of seedlings. Research should also be initiated or developed in the following fields: short rotation forestry, pathological aspects of densely planted and coppiced stands, action of intensive production on the environment, harvesting techniques adapted to small plots, sociological and economic integration of this production in existing farmed and forested areas.

7379 **(EUR—9956) Investigation on ion implantation as a technique suitable to fabricate high efficiency silicon solar cells ion implanted, electron beam annealed cells: Final report.** Galloni, R.; Merli, P.G. (Consiglio Nazionale delle Ricerche, Rome (Italy)). 1985. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900229/JAW.

The activity developed during the last period of this CNR-EEC Research Contract concerned the investigation of ion implantation and solid phase electron beam annealing as techniques suitable for fabricating high efficiency solar cells. In order to work out this research plan, the following topics have been dealt with: (1) construction and testing of an electron gun especially designed for application to solar cell annealing; (2) comparison between electron beam and furnace isothermal annealing of solar cells; (3) numerical analysis of solar cell performance; (4) fabrication and characterization (including double crystal x-ray diffractometry with an instrument designed for this purpose) of tailored emitter ion implanted solar cells; and (5) analysis of thermal stresses induced in silicon during fast annealing. 11 refs., 14 figs., 1 tab.

7380 **(EUR—9958) Amorphous silicon photovoltaic junctions produced by gas-phase doping and by ion implantation.** Spear, W.E.; Kalbitzer, S.; Le Comber, P.G.; Reinelt, M.; Kinmond, S.; Demond, F. (Commission of the European Communities, Luxembourg). 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750614/JAW.

The two main aims of the joint Dundee-Heildelberg project were to explore the design and properties of a-Si photovoltaic junctions and to investigate electronic and structural properties of the material relevant to its photovoltaic applications. A-Si solar cells have been produced using both gas phase and implantation doping. It is shown that both techniques lead to devices with conversion efficiencies between 5 and 6% and it is suggested that ion implantation is the solution to the 3-chamber process of deposition now used in mass production. Fast transient techniques have been developed for direct application to photovoltaic cells to provide information on carrier mobilities, lifetimes and the built-in field. One of the most important conclusions has been that the observed 'lifetime limitations' are determined by the non-uniformity of the internal field of the junctions and not by the electronic properties of the material. The controversial problem of photogeneration has been investigated. It is shown that in a-Si germinated recombination plays a negligible part at photon energies above the band gap and that the quantum efficiency for photogeneration lies between 0.9 and 1.0. Depth profiles of H and other elements have been measured using nuclear techniques in order to control the actual impurity distribution introduced by gas phase and ion implantation processes. The important question of atomic diffusion is disordered systems has been systematically investigated using the a-Si system and representation members of most important impurity groups. So far, the general conclusion is that diffusion in a-Si is impeded rather than enhanced over the crystalline matrix.

7381 **(EUR—9986) Low cost implantation into silicon.** Muller, J.C.; Siffert, P. (Commission of the European Communities, Luxembourg). 1985. 90p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750608/JAW.

The work outlined here concerns optimization of an "ion incrustation technique": implantation without mass separation, and pulsed annealing by YAG laser for production of junctions on silicon. The ion incrustation process is based on gas discharge in a gas containing the dopant (PF/sub 5/). The plasma established at a voltage of 6 to 10 kV creates an ion beam which is accelerated towards the substrates to be doped at voltages from 2 to 50 kV. The machine developed includes two work stations processing the wafers continuously: for doping and activation annealing by laser, respectively. In annealing, the pulses cause melting of a very small thickness of silicon followed by rapid epitaxial recrystallization which enables incorporation of heavy concentrations of dopant on the silicon substitution sites, a theoretical model indicates the level of energy required to melt a given thickness. The residual faults have been compared with results obtained in ruby laser annealing. Ion incrustation and pulsed laser annealing were applied to the production of mono-and polycrystalline silicon solar cells of 11 cm/sup 2/ area. This process has also been applied to different type of polycrystalline silicon; it has been demonstrated that atomic hydrogen can be used to remove the grain boundary effects. The possibilities of ion implantation without mass separation have been considered for passivation of grain boundaries.

7382 **(EUR—10613) The results of the 1984/1985 Round-Robin Calibration of Reference Solar Cells for the Summit Working Group on Technology, Growth and Employment.** Ossenbrink, H.; Van Steenwinkel, R.; Krebs, K. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1986. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900215/JAW.

In view of the necessity for common evaluation methods for photovoltaic devices, the Technology, Growth and Employment

Working Group of the Summit initiated 1984 a Round Robin Calibration of Reference Solar Cells in the frame of a Collaborative Project in Photovoltaic Solar Energy. This calibration campaign was performed successfully in 1984/1985 and included 18 crystalline and amorphous silicon solar cells from 5 different manufacturers. All summit countries contributed to the calibration, involving 8 experienced laboratories. The Joint Research Centre of the Commission of the European Communities, Ispra Establishment, performed the initial and final calibration and served as the operating agent. This report presents the results of the calibration and describes details of the calibration techniques used at the Joint Research Centre. 5 refs., 11 figs.

7383 **(FRNC-CONF—248) Agricultural biomass.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 230p. (In French). (CONF-8404335—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750583/JAW.

From Seminar on agricultural biomass; Orsay, France (17 Apr 1984).

The various communication of a symposium on biomass plantation and conversion are reported. In a first chapter, some lignocellulosic cultivations are presented: Genista, Phragmites reeds, and Provence cane. In the second chapter, cultivations techniques and energetic conversion processes of saccharifierous plants are described: Jerusalem artichoke, high dry matter rate beets. In the last part, the different agricultural dry wastes are reviewed and the various up-grading and energy production systems are presented and discussed: straw, high density packed straw, granulated straw, straw combustion, corn cobs, drying and combustion of corn cobs, corn stalk utilization for acetono-butylic fermentation, vine tendrils recovery and conversion.

7384 **(FRNC-TH—3106) Study of the fermentation of the hydrolysis products from cellulose with yeasts.** Gonde, P. (Montpellier-1 Univ., 34 (France)). 14 Nov 1984. 167p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88750581/JAW.

The cellobiose is one of the major cellulolysis products and its occurrence in the final hydrolyzate is undesirable. The aim of this work was to realize the fermentation of the cellobiose and of the cellodextrins by the means of yeasts. Various yeast phyllums have been tested and for one of them, phyllum Torulopsis molischiana, the enzymatic system involved in the hydrolysis of cellobiose and cellodextrins have been studied.

7385 **(PB—88-112461/XAB) Solar-fuel synthesis based on colloidal and particulate semiconductors. Annual report, August 1, 1986-July 31, 1987.** Frank, A.J.; Graetzel, M. (Solar Energy Research Inst., Golden, CO (USA)). 15 Aug 1987. 69p. NTIS, PC A04/MF A01.

See also PB—87-144333.

A very reactive and durable water-oxidation catalyst L(2)($H_2O$)Ru-O-Ru($H_2O$)L(2) has been isolated and characterized by electrochemical and spectroscopic techniques. A stable colloidal linear chain complex PBC, ($Pt(bpy)_2$)($Pt(CN)_4$) has been prepared and characterized for visible light-induced $H_2$ production from water. Very active (in some cases air stable) $H_2$ generating species have been discovered and characterized. New cyclometallated and linear chain Pt complexes have been prepared and found to effectively photosensitize, with visible light, the reduction of water. A titania-supported ruthenium catalyst has been developed for the (photo)methanation of $CO_2$ by $H_2$ at room temperature and atmospheric pressure. Cheaply and easily prepared sensitized thin $TiO_2$ films with a surface roughness factor of 280 display unprecedentedly incident photon to current conversion efficiencies of 73% in the visible in the presence of iodide. Bromide is oxidized with 56% efficiency. A regenerative cell based on the $Br_2$/Br redox couple gives a monochromatic light to power conversion efficiency of 12% with a fill factor of 0.74. Time-resolved laser spectroscopy has revealed that the recombination between electrons and holes can be drastically retarded by introducing dopants such as Fe(III) in colloidal $TiO_2$ particles.

7386 **Expression of the Escherichia coli xylose isomerase gene in Saccharomyces cerevisiae.** Sarthy, A.V.; McConaughy, B.L.; Lobo, Z.; Sundstrom, J.A.; Furlong, C.E.; Hall, B.D. (Univ. of Washington, Seattle). *Applied and Environmental Microbiology;* **53**: No. 9, 1996-2000(Sep 1987). Contract AT06-81ER10879.

Transformation of Saccharomyces cerevisiae by yeast expression plasmids bearing the Escherichia coli xylose isomerase gene leads to production of the protein. Western blotting experiments show that immunoreactive protein chains which comigrate with the E. coli enzyme are made in the transformant strains and that the amount produced parallels the copy number of the plasmid. When comparable amounts of immunologically cross-reactive xylose isomerase protein made in E. coli or S. cerevisiae were assayed for enzymatic activity, however, the yeast protein was at least $10^3$-fold less active.

7387 **Polysilicon resistor modification with hydrogen plasmas on fabricated integrated circuits.** Ginley, D.S.; Hellmer, R.P.; Lum, W.Y. (Sandia National Labs., Organization 1144, Albuquerque, NM 87185). *Journal of the Electrochemical Society;* **134**: No. 8A, 2078-2079(Aug 1987). Contract AC04-76DP00789.

Over the course of the last five to six years, it has been demonstrated that monatomic hydrogen plasmas can be quite effective in passivating the defect states in polycrystalline silicon grain boundaries. As the density of grain boundary defects is reduced, significant increases in majority conduction across the boundary are observed along with a large reduction in the number of minority carrier traps. In polysilicon solar cells, significant junction improvements are observed as well. These improvements in material and device properties are significant enough to warrant the incorporation of these processes in a number of commercial polysilicon solar cell process lines.

7388 **Accelerated stress testing of commercial a-Si:H solar cells.** Lathrop, J.W.; Davis, C.W.; Royal, E.L. (Clemson Univ., SC, USA). pp 293-297 of Seventh E.C. photovoltaic solar energy conference. Goetzberger, A.; Palz, W.; Willeke, G. (eds.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1987). (CONF-861021—).

From 7. European photovoltaic solar energy conference; Sevilla, Spain (27 Oct 1986).

Four types of commercial, in situ fabricated, single junction and one type of tandem junction a-Si:H sub-modules were subjected to 140 C testing, both in the dark and under illuminated conditions. A short term effect was noted which dramatically improved cells with low Voc on one type of single junction construction. All cells eventually showed long term irreversible degradation, but the time to 50% power reduction varied by more than two orders of magnitude depending on cell construction. No basic difference could be detected between degradation under illuminated or non-illuminated conditions or when cells were either open or short circuited. The tandem cell showed marked superiority to the single junction cells. Physical examination of degraded cells indicated movement of contact material into the amorphous silicon film. 6 figs., 4 refs.

7389 **Influence of reference cell and spectrum on the measurement of solar cells.** Pearsall, N.M.; Emery, K.A.; Davies, M. (Solar Energy Research Institute, Golden, CO, USA). pp 298-303 of Seventh E.C. photovoltaic solar energy conference. Goetzberger, A.; Palz, W.; Willeke, G. (eds.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1987). (CONF-861021—). Contract AC02-83CH10093.

From 7. European photovoltaic solar energy conference; Sevilla, Spain (27 Oct 1986).

This paper concerns itself with two aspects of cell measurement procedure, these being the choice of reference cell and the influence of the reference spectrum. Data are presented for several different types of cell. 1 fig., 3 tabs., 12 refs.

## 1406 Photovoltaic Power Systems

7390 (ESA-SP—267, pp vp) **Space station power system.** Baraona, C.R. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The major requirements and guidelines that affect the NASA Space Station configuration and the power system are explained. The evolution of the Space Station power system from the NASA program development-feasibility phase through the preliminary design phase is described. Early station concepts, both fanciful and feasible, are described and linked to the present concept. The Phase B trade study selections of photovoltaic system technologies are detailed. Solar dynamic and power management and distribution systems are summarized.

7391 (ESA-SP—267, pp vp) **Alternative power generation concepts for space.** Brandhorst, H.W. Jr.; Juhasz, A.J.; Jones, B.I. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Trade and optimization studies that highlight the potential of solar and nuclear dynamic systems relative to photovoltaic power systems are summarized. The solar dynamic case is the LEO Stirling system, while the nuclear system is the SP-100 system goal. Nuclear systems have the potential for the lightest weight, least area, sunlight independent, radiation-durable system. Solar dynamic systems pose a stiff challenge to photovoltaic systems in the midaltitudes because of their insensitivity to the Van Allen radiation belts. While the initial operational capability space station power system is only slightly superior to the SOA PV system, with development focused on the key technologies, advanced solar dynamic systems are fully competitive in LEO midaltitudes with the advanced photovoltaic systems. Advances in energy storage systems (100 Whrs/kg required) are essential.

7392 (ESA-SP—267, pp vp) **Solar generator for spectrometer power supplying on mission Phobos.** Ojanen, P.; Olsen, S. (Kiruna Geophysical Institute, Sweden). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

The solar generator of the Automatic Space Plasma Experiment with Rotating Analyzer (ASPERA) is described. The ASPERA is a scanning cosmic plasma analyzer to fly on board spacecraft Phobos to be launched towards Mars and Martian moon Phobos in 1988. Since the available power from the spacecraft is limited, the small solar generator produces extra power to maximize the operational life of the instrument.

7393 (ESA-SP—267, pp vp) **Questionnaire on photovoltaic power.** Nieuwenhuizen, M.P. Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Almost 80 experts on photovoltaic generators in space were asked to predict trends in the 1990's. A strong increase of launched power is expected by 67% of the sample in the period 1995-2000. A moderate increase of launched powere is expected by 65% of the sample in the period 1990-1995. A large percentage expects that GaAs cells will already play a noticeable role in the period 1990-95. Thermodynamics and other methods are expected to play a less important role. However, there is an increase foreseen for the far future.

7394 (EUR—9991) **Photovoltaic system for a solar house.** Bopp, G.; Koethe, H.K.; Schmid, J. (Commission of the European Communities, Luxembourg). 1986. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750616/JAW.

The first German utility interactive photovoltaic residential system has been developed and installed in a private residence; it is the result of a project managed by the Fraunhofer-Institute for Solar Energy Systems (ISE) at Freiburg and sponsored by the Commission of the European Communities and several firms of German industry. In general the house is designed for optimum passive heat gain. At present, 30 m/sup 2/ of solar cells have been installed, 20 m/sup 2/ of them, however, behind glass. Consequently the DC output is being limited to 1.6 kW/sub p/ instead of a potential 5kW/sub p/. A storage battery of the nickel-cadmium type (to store 10 kWh) has been designed and installed, however, in order to study the system without battery back-up, but it has not yet been put into service. Thus the solar generator feeds the energy converted directly into the public grid via an inverter, developed by the ISE especially for use in photovoltaic power supply systems with AC output. It has inherent safety functions and produces sine waves with low harmonic distortion. A five years'test period is planned in order to obtain all information needed on the system's operation.

7395 (EUR—10187) **Interconnection of 5 KWP photovoltaic solar panels with the electric low voltage utility grid. Demonstration project.** Baert, D.; Simoens, H. (Commission of the European Communities, Luxembourg). 1986. 280p. (In English and Dutch). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750607/JAW.

The report describes a 5 kW installation consisting of a photovoltaic generator, a battery and a dc-ac inverter connected to the utility grid and suited for residential applications. In the first part the technical details of the installation are given: the circuits of two types of inverters, general wiring diagram, protections,... The second part concerns the measurement system that will allow to collect data of irradiation, system effficiency,... In the last part the commercial viability of the installation is considered. This study has been performed by means of computer simulations that use Belgian meteorological data. It is found that the prices of the photovoltaic cells are the bottleneck for future applications. This project has been realized in the framework of the Demonstration Programme in the Solar Energy Field carried out by the Commission of the European Communities. It has been funded by 33.8% of its total cost.

## 1407 Solar Thermal Power Systems

*REFER ALSO TO CITATION(S) 7303, 7391*

7396 (ESA-SP—267, pp vp) **Organic Rankine cycle power conversion systems for space applications.** Farina, F.; Mao, C.; Tuninetti, G. (Ansaldo S.p.A., Genoa, Italy). Nov 1986. NTIS, PC A21/MF A01. (ETN—87-90157; CONF-8609216—).

From 5. conference on photovoltaic generators in space; Noordwijk, Netherlands (30 Sep 1986).

Use of a Rankine heat engine in the Electric Power System (EPS) of a Space Station to convert heat into electricity is discussed. Concentrated solar energy is used to heat a working fluid which in turn drives a turbine operating in a Rankine cycle defined on the basis of the criteria required by a tens of kW EPS. For high reliability, long life, high power/mass ratio, and low collector and radiator area, procedures to optmize the selection of the system and to evaluate the influence of each component on the EPS performance are presented. Tests with toluene and PP3 are proposed.

7397 **Using an expert system for PV technology transfer.** Zwibel, H.S.; Risser, V.V. (New Mexico Solar Energy Institute, Las Cruces, USA). pp 216-220 of Seventh E.C. photovoltaic solar energy conference. Goetzberger, A.; Palz, W.; Willeke, G. (eds.). Dordrecht, Netherlands; D. Reidel Publishing Co. (1987). (CONF-861021—).

From 7. European photovoltaic solar energy conference; Sevilla, Spain (27 Oct 1986).

The New Mexico Solar Energy Institute has the mandate from the New Mexico State Legislature to inform the citizens of the state on the latest developments in alternative energy. There are many citizens who live and work in isolated areas in the 121,000-square-mile state. In the past few years, a significant increase in the requests for information about stand-alone photovoltaic systems have been received. The needs are diverse; water pumping, domes-

tic use, electric fencing, communications, etc. Because of the distances involved, and a limited staff, it is difficult to address personally the needs of these citizens. For this purpose, an expert system program is being developed. The intent is to distribute the program to the farm extension offices in the 33 counties of the state. Using this program the citizens will be able to answer the following questions: should PV be considered for my application; what size system do I need, and how much will it cost; what performance can I expect from a PV system, and how can I adjust my load to optimize PV system output. 1 fig., 1 ref.

## 1409 Solar Thermal Utilization

*REFER ALSO TO CITATION(S) 7530*

7398 **(EUR—9518) Development and validation of a sophisticated simulation model and a simplified design tool.** Boland, F.M.; Frank, M. (Commission of the European Communities, Luxembourg). 1986. 81p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88750613/JAW.

This report summarizes the contribution of the M2 participants from the Republic of Ireland to the Commission of the European Communities Solar Energy R and D programme. The work was carried out under research contract No.ESA-M-088-EIR. The report describes how an initial version of a common solar system modelling program, EMGP1, has been implemented and verified using data from national pilot test facilities. These verification studies reveal certain restrictions and limitations in EMGP1, and, consequently a more generalized and flexible program, EMGP2, has been implemented. Using EMGP2, a variety of solar system have been studied and the accuracy of the model has been assessed. Studies using experimental data have shown that errors in this data are the most probably cause of inaccuracies in some simulations. Work on simplified methods for the prediction of monthly or annual system performance has been conducted. This work has resulted in an European simplified method that shows better accuracy than existing methods.

7399 **(EUR—9837) Self operating absorption cooling system using solar energy: Small power experimental plant: Final report.** Velluet, P.; Dehausse, R. (Ecole Nationale Superieure des Mines de Paris, 75 (France). Centre d'Energetique Armines). 1986. 89p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900194/JAW.

This study deals with a solar system for refrigeration specially designed for remote areas conditions. So, it must be very simple and reliable, and in addition it must be also mechanically self-operating. The thermodynamic cycle used is an ammonia-water absorption one. Its consumption is only thermal energy, easy and cheap to produce by direct conversion of solar radiation. In order to make a self-operating system, an engine is located between the boiler (at high pressure) and the absorber (at low pressure). It expands ammonia vapor and produces mechanical energy to run the solution pump. 10 refs., 22 figs.

7400 **(EUR—9913) Conception, realization and on-site test of a solar-powered cold store using zeolite $H_2O$ pair: Conception and realization of a solar-powered ice maker using the activated carbon-methanol pair: Final report.** Grenier, P.; Guilleminot, J.J.; Meunier, F.; Pons, M. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. de Thermodynamique des Fluides). 1985. 57p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900234/JAW.

This final report presents results of a study which had two objectives: (1) test the feasibility of the zeolite-$H_2O$ pair to medium size solar powered cold stores; (2) find a new pair so as to realize a solar powered ice maker. The zeolite-water pair allows to build solar powered units ranging from small individual refrigerators (for camping or for vaccine storage) to medium size cold stores. In our study, we did not notice any important size effect between our small units and the 12 $m^2$ (with 20 $m^2$ solar collectors) unit. The activated carbon-methanol pair can be used as well as the zeolite-water pair for conservation at +5°C. The activated carbon pair can be used to operate a solar powered ice maker. The scale which seems to be realistic for the application of that pair ranges from very small units to units producing some hundreds of kilograms of ice per day. 7 refs., 18 figs.

7401 **(EUR—10205) European modelling group. Solar space heating and domestic hot water systems.** McGrath, E. (Commission of the European Communities, Luxembourg). Jan 1985. 191p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88750611/JAW.

This report covers the work performed by the UK participants in the European Modelling Group (EMG) from July 1981 to June 1983. Eight countries were involved in this coordinated project. The aim was to develop and test a detailed simulation model capable of predicting the performance of a wide range of solar space heating and domestic hot water systems in a range of climates typical of Europe. This model would bring together each participant's experience with their own simulation models in the previous work of the EMG. Having developed the model it would be used in studies of various systems. At the same time, the available simplified methods would be examined and from these a number would be improved and developed in order to produce an European simplified method.

7402 **(EUR—10504) Eursol. A series of interactive system specific simulation programs for thermal solar systems.** Dutre, W.L.; Debosscher, A.; Gosiau, S. (Commission of the European Communities, Luxembourg). 1986. 270p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750612/JAW.

System specific simulation programs have been developed as a set of solar system design tools at an intermediate level between the generalised modular simulation program EMGP2 and simplified correlation methods. The physical component models used as well as the integration algorithm are identical to the simplest options of the components and integration procedure of EMGP2, although also additional features have been added which are not directly available in EMGP2. A set of 12 system specific simulation programs and a solar radiation data processing program which can be run on small computer systems (64 Kbyte) have been developed. In order to account for the rapidly increasing use of more powerful personal computer systems, also a more general program, called EURSOL, has been developed, including 20 different solar system configurations as well as the solar radiation processing. All programs are fully interactive and user friendly. As an accompanying user support, a graphical program showing the scheme of each of the presently available systems in this program package and a file with fully detailed explanatory texts on all systems, input and output and all system parameters have been developed. The interactive input procedure of Eursol gives access to an applicable part of the explanatory text file at all levels of the input procedure. The simulation program package, together with the graphical program, the text file and appropriately formatted test reference years are all available on double sided 360-Kbyte diskettes for direct use with a microcomputer system working under the MS/sub TM/-DOS-2.0 operating system or later versions.

7403 **(FRNC-TH—2155) Water heating by solar energy through the soil: application to the implementation of a direct condensation heat pump.** Soulas, M. (Perpignan Univ., 66 (France)). 1983. 250p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88750592/JAW.

Mathematical models have been developed for the study of the heat and mass transfers in the soil, considered as a porous medium collector with a water flow. The time and spatial distribution of the solid and liquid phase temperatures are computed and the numerical results are applied to the design of a condensation heat pump operating with natural convection for the space heating of a dwelling-house.

7404 **(FRNC-TH—2157) Solar cooling by absorption refrigerating machines.** Beguin, D. (Perpignan Univ., 66 (France)). 1983. 257p. (In French). NTIS (US Sales Only), PC A12/MF A01. Order Number DE88750603/JAW.

An absorption refrigerating unit for solar cooling application have been tested at various part load rates. A physical model is developed, on the basis of the thermodynamical cycle and heat transfer characteristics, to evaluate the effects of various internal and external parameters on the unit performance. A simulation of the cooling equipment (solar collectors, storage tank, refrigerating set, and distribution equipment) is presented and the energy balance of the system is evaluated.

7405 **(SERI/TR—254-3094) Testing and analysis of load-side immersed heat exchangers for solar domestic hot water systems.** Farrington, R.B.; Bingham, C.E. (Solar Energy Research Inst., Golden, CO (USA)). Oct 1987. Contract AC02-83CH10093. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001121/JAW.

This report describes work to determine the performance of load-side heat exchangers for use in residential solar domestic hot water systems. We measured the performance of four heat exchangers: a smooth coil and a finned coil having heat transfer areas of 2.5 $m^2$ (26 $ft^2$) and those having areas of 1.7 $m^2$ (19 $ft^2$). A numerical model using the thermal network program MITAS was constructed, and results were compared to the experimental results. Research showed a smooth coil with only 70% of the surface area of a finned coil performed better than the finned coil. Also, load-side heat exchangers can maintain and enhance stratification in storage tanks, permitting the use of control strategies that take advantage of stratified storage tanks to increase system performance. The analytical model, which agreed reasonably well with the experimental results, was used to vary heat exchanger flow rate and area and initial tank temperature for both a smooth- and a finned-coil heat exchanger. Increasing the heat exchanger flow rate and area results in higher heat transfer rates but not necessarily optimal performance. Lower initial tank temperatures resulted in reduced tank stratification. The smooth heat exchanger outperformed the finned heat exchanger with the same outside surface area. 15 refs., 37 figs., 9 tabs.

## 1410 Solar Collectors And Concentrators

7406 **(SAND—87-1787) The effect of asymmetric heating on flow stability and heat transfer for flow in a vertical tube.** Tappan, C.H. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003242/JAW.

This study presents experimental results of combined free and forced convection heat transfer in a vertical tube with a circumferentially nonuniform constant wall heat flux. The effect of an asymmetric wall heat flux on flow stability and on the rate of heat transfer for water flowing downward in a vertical tube was investigated. Experimental results were used to develop two stability maps which identify various flow regimes, corresponding to different thermal and hydraulic conditions. Heat transfer coefficients were also determined. Experimental results in the present investigation were compared to those with uniform heating in horizontal and vertical tube flow situations discussed in the literature. 23 refs., 12 figs., 1 tab.

## 1420 Heat Storage

*REFER ALSO TO CITATION(S) 7530, 7531*

7407 **(AFME—82-222) Investigations into characterization methods of heat storing units.** Achard, P.; Hayet, D. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 134p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750600/JAW.

A new solar storage test facility where fuel scale tests and simulations may be conducted, is described. The new facility is driven automatically by a computer and the operating conditions are extended (as a comparison to the previous storage test facility). A latent heat storage system is described and evaluated and the results of the tests lead to propositions and recommendations for solar heat storage design. The measuring instrumentation is described extensively.

7408 **(FRNC-TH—2330) Fundamental study of coupled heat and humidity transfer in a non saturated porous medium.** Crausse, P. (Institut National Polytechnique, 31 - Toulouse (France)). 1983. 297p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88750591/JAW.

The coupled phenomena of heat and humidity unidirectional transfer developed in an isotropic, homogeneous, non saturated porous medium, subject to low temperature gradients have been experimentally and numerically studied. The simulation model used (Luikov) for the prevision of the phenomena under extreme conditions (dessication, humidity accumulation) is verified by comparing experimental results and numerical simulation data.

# 15 GEOTHERMAL ENERGY

7409 **(EUR—10173) Nomenclature of terms used in the geothermal industry (in five languages: English, French, German, Italian and Spanish).** Ten Dam, A.; Ten Dam-Schreuder, A.C. (eds.). (Commission of the European Communities, Luxembourg). 1986. 195p. (In English, French, German, Italian and Spanish). NTIS (US Sales Only), PC A09. Order Number DE88750617/JAW.

The glossary contains equvalents in English, French, German, Italian and Spanish of some 2357 terms currently used in exploration and development of high and low enthalpy geothermal resources.

## 1503 Geothermal Exploration And Exploration Technology

*REFER ALSO TO CITATION(S) 7922*

7410 **(EUR—10674) Magnetotelluric feasibility study: Island of Milos, Greece.** Dawes, G.J.K. (Edinburgh Univ. (UK). Dept. of Geophysics). 1986. 45p. NTIS (US Sales Only), PC A03. Order Number DE88900220/JAW.

Milos lies in an important tectonic zone and has been known for some years to be a potential geothermal area. Recently drilled boreholes have produced steam in sufficient quantities to justify the planned construction of an electricity generating station. In order to determine the usefulness of Magnetotelluric (MT) methods in this situation, Edinburgh University was invited to undertake a feasibility study. This report covers the findings of that study. The main objectives were to: (1) estimate the extent of contamination by near-field artificial "noise" sources, as were observed at the Travale test site, Italy; (2) compare results with borehole logs and geo-electric surveys already undertaken; (3) produce an optimum strategy for exploration in terms of site distribution and frequency band range; and (4) investigate the logistics of carrying out a MT survey on the island. The instrumentation used was a SPAM (Short Period Automatic Magnetotelluric) Mk II system. The frequency range is 100 Hz to 0.02 Hz with in-field analysis up to 1-D modeling.

7411 **Use of an acoustic borehole televiewer to investigate casing corrosion in geothermal wells.** Carson, C.C.; Bauman, T. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). *Materials Performance;* 26: No. 6, 53-59(Jun 1987). Contract AC04-76DP00789.

Corrosion of well and surface equipment resulting from the presence of hot, corrosive brines is one of the major problems facing geothermal operators. For wellbore casing, this problem is complicated by the fact that inplace inspection is difficult at best. In an attempt to improve this situation, a prototype acoustic borehole televiewer designed to operate in geothermal wells was used to study the corrosion damage to casing in three commercial wells. The results of this experiment were promising. The televiewer returns helped defined the areas of major corrosion damage and indicate the extent of the damage.

## 1509 Geothermal Engineering

7412 **(EUR—10344) Interpretation of the scribing test in geothermal tank on fractured rock.** Goblet, P.; Bigot, S.; Batchelor, A.S. (Commission of the European Communities, Luxembourg). 1986. 55p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750618/JAW.

The life span of a geothermal doublet in Hot Dry Rocks depends on the contact area through which the water extracts calories from the rock. The use of chemical tracers is of great interest to characterize the connexion between the wells since the transfer of tracers takes place in the same fracture zones as the heat exchange while being much quicker. From the recovery curve of a perfect tracer one can deduce a "spreading function" which gives, among other things, the water-rock contact area. This function can be used also in prediction models for the thermal behaviour of the doublet. This methodology was applied on the site of the Geothermal Energy Project of the European Community Commission in Camborne (U.K.), in a joint project of the Camborne School of Mines, the Laboratoire de Geochimie Comparee et Systematique of Paris-6 University and the Centre d'Informatique Geologique of the Ecole des Mines de Paris. Tracers used and interpreted were Fluorescein and two EDTA complexes with Dysprosium and Ytterbium. Discrepancies in the volume found for the reservoir suggest a retention of Fluorescein. Simultaneously other Rare Earth-EDTA complexes presenting a retarding behaviour were injected, but the interpretation of these results was impossible due to analytical problems. These results confirm the interest of chemical tracers as a quick survey method giving information on the evolution of the reservoir. However they show that a preliminary characterization of the exchanger structure is necessary for the results to be used in predictions of the "aging" of the doublet, and that possible retention mechanisms should be recognized and quantified through independent measurements.

7413 **Effects of noncondensible gases on fluid recovery in fractured geothermal reservoirs.** Bodvarsson, G.S.; Gaulke, S. (Lawrence Berkeley Lab.). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* 2: No. 3, 335-342(Aug 1987). Contract AC03-76SF00098.

Numerical simulations are performed to investigate the effects of noncondensible gases (CO/sub 2/) on fluid recovery and matrix depletion in fractured geothermal reservoirs. The model is of a well producing at a constant bottomhole pressure (BHP) from a two-phase fractured reservoir. The recoverable fluid reserves are shown to depend strongly on the amount of CO/sub 2/ present in the reservoir system. The results obtained revealed a complex fracture/matrix interaction caused by the thermodynamics of H/sub 2/O/CO/sub 2/ mixtures. Although the matrix initially contributes fluids (liquid and gas) to the fractures, the flow directions later reverse and the fractures backflow fluids into the matrix. The amount of backflow depends primarily on the flowing gas saturation in the fractures; the lower the flowing gas saturation in the fractures, the more backflow. An analytic expression has been derived that allows for the determination of mass backflow on the basis of wellhead measurements of noncondensible gases and flowing enthalpy.

## 1520 Geothermal Data And Theory

*REFER ALSO TO CITATION(S) 7408*

# 17 WIND ENERGY

## 1706 Wind Energy Engineering

7414 **(EUR—10790) Data on existing wind energy converters in Denmark.** Bjerregaard, E.T.D.; Jensen, S.A.; Paulsen, U.S. (Skibsteknisk Laboratorium, Lyngby (Denmark)). 1986. 97p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900199/JAW.

The aim of this project has been to collect available data on existing wind energy converters (WEC) in Denmark. They have been collected on the basis of a general data sheet developed by ERA, UK, for common use by all EEC-participants in similar data collection projects in their respective countries. Per 1st January 1983 there were about 734 wind mills in operation in Denmark. The number of machines included in this project is 47, which represent different types with rated power between 3 kW and 2000 kW. Approximately half of the types reported are commercially available today. Different designs of wind turbines are represented, but the main part of the machines is a stall-regulated type with a three-bladed rotor and fixed blades placed upwind of the tower. The most common way of energy conversion is by means of one or two generators connected to the electric grid. Measured power curve characteristics are available for some of the machines, and the annual energy production has in those cases been calculated as a function of the annual mean wind speed. The present report contains a description of the procedure that has been used for the collection of the available data, a few remarks concerning the quality of the data, and in addition some general characteristics of the status of wind energy application in Denmark. 4 refs., 2 figs., 3 tabs.

7415 **(EUR—10791) Collecting of new data on existing wind energy converters: Final report.** Jensen, S.A.; Bjerregaard, E.T.D.; Paulsen, U.S. (Skibsteknisk Laboratorium, Lyngby (Denmark)). 1986. 77p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900221/JAW.

Measurements on a 55 kW VESTAS wind turbine were carried out during a period of approximately 2 months. The wind turbine is erected at a farm, and the produced energy is used for central heating and in cooling and drying systems at the farm. The energy production of the wind turbine is calculated as a function of the annual mean wind speed, and it is assumed that the wind speed frequency distribution is a Rayleigh distribution. The energy production during a period of 46 days from January the 20th to March the 7th 1983 was 20,665 kWh, and the total energy consumption by the owner in the same period was 12,983 kWh. The mean wind speed at hub height during the same period was 7.6 m/s. Approximately 8975 kWh or 69 per cent of the consumption was delivered directly from the wind turbine, and 11,690 kWh produced by the wind turbine was sold to the power supply company. 38 figs., 7 tabs.

7416 **(EUR—10995) Realization and demonstration of a wind turbine of 200 kW demonstration project: Final report.** Armstrong, J.R.C.; Lindley, D.; Lord, R.; Rendall, P.L. (Wind Energy Group Ltd., Southall (UK)). 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900207/JAW.

This report describes the design, construction, and testing of an intermediate size wind turbine. The wind turbine was built from off-the-shelf components from various European manufacturers. After the machine was installed, performance data were gathered for several months and are presented in this paper. 16 figs., 2 tabs. (JDH)

# 20 ELECTRIC POWER ENGINEERING

## 2001 Power Plants And Power Generation

*REFER ALSO TO CITATION(S) 7170, 7209, 7211, 7212, 7438, 7465, 7558, 7733, 7734, 7737, 7738, 7739, 7740*

7417 (EPRI-CS—5186, pp 5.1-5.19) **Baghouse operation at the TVA/EPRI 20 MWe pilot plant.** Cushing, K.M.; Boyd, T.J.; Carson, W.R. (Southern Research Institute, Birmingham, AL). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Research and development of utility-scale atmospheric fluidized-bed combustion (AFBC) units and industrial AFBC applications in recent years has shown AFBC boilers to be a viable alternative to pulverized-coal power plants with wet limestone scrub-

bers. As a means of gaining design and process information, the Tennessee Valley Authority (TVA) built a 20-MWe AFBC pilot plant at the Shawnee steam plant near Paducah, Kentucky. The plant utilities a reverse-gas cleaned baghouse for final particulate control, and is an intermediate step between the small process developmental units and commercial-size utility demonstration power plants. As part of a four-year test program cofunded by TVA and the Electric Power Research Institute (EPRI), a baghouse monitoring program was implemented to determine the effects of the AFBC process particulates on baghouse operation and performance. This paper summarizes the results of the program, which has an operating history of over 13,000 hours to date. Data will be presented on tube sheet pressure drop, ash characteristics, and emissions, and comparisons will be made with PC baghouse data. Preliminary observations highlighting pressure drop trends and possible causes will be made, and future testing plans presented.

7418 (EPRI-CS—5186, pp 6.1-6.12) **TVA 20-MWe pilot plant operating experience.** Bass, J.W. III. (Tennessee Valley Authority, Chattanooga). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The Tennessee Valley Authority (TVA) has responded to the challenge of developing atmospheric fluidized-bed combustion (AFBC) for the utility industry with a comprehensive research program that addresses the major technical uncertainties associated with the AFBC process. A cornerstone of this research program is the 20-MWe AFBC pilot plant located at TVA's Shawnee Steam Plant Reservation near Paducah, Kentucky. This engineering facility simulates power plant operating conditions and has the flexibility to compare and screen the various options for feeding, fly ash reinjection, and control using commercial-sized equipment. The knowledge gained from the 20-MWe pilot plant is being applied to the design of TVA's 160-MWe AFBC demonstration plant as well as other large-scale demonstration and commercial AFBC plants. Operation of the 20-MWe pilot plant has been funded by a joint TVA and Electric Power Research Institute (EPRI) test program designed to answer the critical technological questions. The test program has emphasized investigations of process performance, system and equipment reliability, load following and control system development, and coal and limestone feeding.

7419 (EPRI-CS—5186, pp 7.1-7.17) **Operating experience with pyropower circulating fluidized-bed boilers.** Hurn, E.J. (Pyropower Corp., Evansville, IN). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Pyropower Corporation of San Diego has sold eleven Ahlstrom Pyroflow circulating fluidized-bed (CFB) boiler systems during the last five years, in sizes ranging up to 110-MWe. This paper describes the operating experience with three of these systems, (1) a 191,000-pounds-per-hour (pph) industrial boiler at the Cement Division plant of CalMat Company, Colton, California; (2) a 125,000-pph industrial boiler at the B.F. Goodrich plant, Henry, Illinois; and (3) an 88,000-pph industrial boiler at the Central Soya Co., Inc. plant, Chattanooga, Tennessee. Pyropower Corporation is based in San Diego and is a wholly-owned subsidiary of A. Ahlstrom Corporation of Finland which markets, engineers, and constructs Pyroflow CFB systems for the North American market. Ahlstrom developed Pyroflow technology in the 1960's with bubbling fluidized-bed combustion. In the mid-1970's, however, they redirected their research, development and commercialization efforts to circulating fluidized-bed combustion. Since that time, 22 Pyroflow units have been designed and constructed and approximately a total of 40 have been ordered worldwide.

7420 (EPRI-CS—5186, pp 13.1-13.11) **Update on NSP's Black Dog unit No. 2 AFB conversion.** Boden, B.G. (Foster Wheeler Energy Corp., Livingston, NJ). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The Northern States Power (NSP) Black Dog unit no. 2 is in the process of being converted from conventional firing to atmospheric fluidized-bed combustion (AFBC). This paper summarizes the major features of the conversion and goes on to update the project as it approaches completion of construction. In 1982 NSP decided to investigate conversion of an existing, conventionally-fired generating unit to coal-fired AFBC in order to achieve the following objectives: (1) extend the life of an existing unit and take advantage of the economics (vs. installation of a new unit); (2) reduce stack emissions to help address the issue of acid rain in the region and to be a good neighbor; (3) obtain increased flexibility in fuel procurement for better economics; and (4) advance technology and investigate alternatives for future capacity additions. After NSP completed its investigations, the no. 2 unit at the NSP Black Dog generating station was selected for conversion to AFBC. Black Dog station is on the southern outskirts of Minneapolis, Minnesota and has a total of four units, all in the 100-Mwe range. Unit no. 2 was installed in 1954 and originally rated at 100-Mwe, but in order to comply with emission regulations in an economical manner low sulfur Western coals were increasingly substituted for the original fuel, Illinois bituminous. The coal mix that resulted caused the unit to be derated to approximately 85-Mwe.

7421 (EPRI-CS—5186, pp 16.1-16.29) **Design features of the TVA/EPRI 160-MWe AFBC demonstration project.** Golden, J.L. (Tennessee Valley Authority, Knoxville). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The 160-MWe atmospheric fluidized-bed combustion (AFBC) demonstration plant is being built at TVA's Shawnee steam plant near Paducah, Kentucky, which has ten 160-MWe pulverized coal units (175-MWe generator rating) of identical size and design. The new plant is located beside the existing unit 10, and it's principal distinguishing feature is an AFBC boiler. This boiler will serve as a replacement for the existing boiler and will utilize the unit 10 turbine generator set. The AFBC boiler interfaces with the unit 10 feedwater system, the main and reheat steam system, existing coal handling facilities, the gas duct to the baghouse, and several miscellaneous service systems. The planned arrangement of the Shawnee site near unit 10 is shown in figure 16-1, with an artist's rendering of the AFBC demonstration plant shown in figure 16-2.

7422 (EPRI-CS—5186, pp 17.1-17.21) **Coal drying using recycle fly ash.** McKinsey, R.; Boyd, T.; Jukkola, G.; Moon, N. (Bechtel Corp., San Francisco, CA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The current design for the 160-MWe commercial fluidized-bed combustion (FBC) demonstration plant at the Tennessee Valley Authority (TVA) Shawnee power station utilizes flue gas to dry coal before it is fed to the boiler. Due to pneumatic under-bed feeding, the coal must be dried to less than 6% moisture to assure that it has good flow characteristics and does not become plugged in the feed system. The current design uses equipment that is costly, requires excessive space, and is not readily available. Over the past year TVA, the Electric Power Research Institute (EPRI), and Combustion Engineering (CE) have been working on an alternative process that makes use of the hygroscopic properties of atmospheric fluidized-bed combustion (AFBC) recycle material (char) to dry the coal. In this process a combination of chemical reaction and surface moisture evaporation dries the coal. When wet coal is mixed with recycle ash, the water reacts with calcium oxide (lime) to produce calcium hydroxide and consideration heat (15.5-kcal/gmol). To a lesser extent, some of the moisture in the coal combines with the calcium sulfate present to form either plaster of paris or gypsum. To alleviate these concerns, tests were performed. The

initial laboratory-scale tests were performed by CE's R & D division at its facility in Windsor, Connecticut. These tests were followed by two series of bench-scale tests led by EPRI at the 20-MWe pilot plant in Kentucky.

7423 (EPRI-CS—5186, pp 18.1-18.18) **Application of coal drying systems using recycle material at the TVA demonstration plant.** Jukkola, G.; Peletz, L.; Bourgeois, E.J.; Hill, M. (Combustion Engineering, Inc., Windsor, CT). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Drying coal by mixing cyclone ash (char) with wet coal provides potential economic benefits in the commercialization of AFBC technology. Benefits are gained through lower capital costs, reduced O & M costs, improved reliability, and improved process performance. This concept was jointly evaluated by Combustion Engineering (CE), the Tennessee Valley Authority (TVA), and the Electric Power Research Institute (EPRI) for potential application on the TVA 160-MWe demonstration plant. The evaluation included bench-scale testing, conceptual designs, and economic evaluations. Provisions were made in the demonstration plant design to facilitate a future retrofit of a coal/char conditioning system. Preparations have recently begun to implement prototype testing of this concept at the TVA 20-MWe pilot plant later this year. The potential for drying coal by using the hygroscopic properties of AFBC char was demonstrated by bench-scale tests at CE and at the TVA 20-MWe pilot plant. Drying proceeds both through evaporation and through the chemical reactions that result when wet coal is mixed with char. In the latter case, water reacts exothermically with the calcium oxide and calcium sulfate in the char to produce calcium hydroxide, plaster of Paris, and gypsum. These solid products are dry and easily handled. The balance of this paper describes the arrangement of the system, explains its economic benefits relative to the current demonstration plant design, and details the test program being implemented at the TVA 20-MWe pilot plant to determine the feasibility of the concept.

7424 (EPRI-CS—5186, pp 19.1-19.12) **Description of 80-MWe fluidized-bed retrofit at Montana-Dakota Utilities Co.** Gorrell, R.L.; Strong, D.N. (Babcock and Wilcox Co., Barberton, OH). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

To increase unit capacity and improve overall performance, Montana-Dakota Utilities Company has undertaken an extensive program to upgrade and convert to fluidized-bed combustion it's unit no. 2 at the R.M. Heskett Station. This unit is currently a spreader stoker-fired boiler and is believed to be the largest of its kind in the country. The retrofit will reuse the existing spreader feeder system, the entire boiler convection pass, and the furnace enclosure walls. Few modifications to existing pressure parts will be required, but a new tubular-type air heater and new forced draft (F.D.) fan will be installed. After retrofitting to fluidized-bed combustion, the unit will fire Beulah North Dakota lignite. To evaluate and determine appropriate design parameters, a test burn of the fuel was conducted on the 6′ x 6′ atmospheric fluidized-bed combustion (AFBC) facility at the Babcock and Wilcox (B & W) research center. This test burn was also run to investigate potential agglomeration problems associated with this type of fuel. Results of the test burn are discussed in this paper. This project exemplifies how fluidized-bed combustion can satisfy the utility market's increasing need for power plant upgrades, utilization of available low cost fuel, and emission reductions. Also worth noting is the fact that this is currently the largest utility AFBC contract funded solely by the utility itself.

7425 (EPRI-CS—5186, pp 21.1-21.5) **Overview of EPRI's fuels characterization project.** Petrill, E.M.; Stallings, J.W. Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The ability of atmospheric fluidized-bed combustion (AFBC) units to burn a wide variety of fuels is one of the attributes that attracts utilities to this new coal-combustion technology. However, the costs of verification of fuel flexibility in commercial-size systems is prohibitively time-consuming and expensive. An alternative approach is to characterize fuels using standardized laboratory and small-scale AFBC tests, and then to use scaling correlations to predict performance in commercial systems. This is the goal of EPRI's Fuels Characterization Project.

7426 (EPRI-CS—5186, pp 23.1-23.24) **B & W/EPRI fuels characterization test program initial test results from the 1′ x 1′ AFBC.** Perna, M.A.; Chandran, R.; Duqum, J.N.; Jafari, H.C. (Babcock & Wilcox Co., Alliance, OH). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Since 1978 the Electric Power Research Institute (EPRI) and the Babcock and Wilcox Company (B & W) have been jointly developing atmospheric fluidized-bed combustion (AFBC) technology. To this end, the thrust of the project has consisted of tests in the 6′ x 6′ pilot-scale fluidized-bed combustor (FBC), such that significant data could be generated to aid in developing AFBC as a cost-effective, low-polluting method of combusting coal for electric power generation. As testing proceeded, one of the attractions of AFBC technology was determined to be the ability to burn a wide range of coal types. As a result, the direction of the project was altered to test a large number of coals in order to quantify each fuel's potential for use in an atmospheric fluidized-bed combustor (AFBC). However, testing of this magnitude would be prohibitively expensive in the 6′ x 6′, and so the 1′ x 1′ FBC was chosen for the tests. The smaller unit is sufficient to generate data that can be used for model verification. The effects on performance of superficial gas velocity, bed temperature, bed height, coal and limestone feed sizes, recycle-to-coal feed ratio, and calcium-to-sulfur (Ca/S) ratio were investigated. This paper discusses results of the 1′ x 1′ testing completed to date for Kentucky no. 9 coal, along with comparisons of combustion efficiency results from the 1′ x 1′ and 6′ x 6′ combustors.

7427 (EPRI-CS—5186, pp 24.1-24.17) **Role of FBCBAL in the fuel characterization project.** Divilio, R.J. (Combustion Systems, Inc., Silver Spring, MD). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The utility of EPRI's AFBC Fuels Characterization Program will be greatly enhanced by a performance code applied as a bridge between the bench-scale tests and full-scale plants. The program FBCBAL has been developed for this purpose, and will be used to analyze the test data and predict the operation of full-scale boiler designs. FBCBAL performs simultaneous heat and material balances around an atmospheric fluidized-bed (AFB) boiler, and has been designed so that almost any type of boiler surfacing arrangement can be configured by the data set. One interesting feature of the program is it's use of empirical correlations to predict the effects of load and other operating conditions on the performance of a boiler. Once the proper coefficients are supplied for a given coal, FBCBAL can be used to plan tests, optimize operations, predict performance in new designs, and to aid in the design of new plants. This database will also be used to develop the correlations that FBCBAL needs in order to predict unit performance of new designs. As more data is obtained on a wide variety of coals, more

about the fluidized-bed combustion process will be learned. This knowledge will in turn result in improvements to the correlations that should improve their predictive abilities. As such, the development of these correlations is expected to continue throughout the length of the project.

7428 (EPRI-CS—5186, pp 27.1-27.20) **Experience with simulating an AFBC steam heating plant using ASPEN.** Young, B.; Douglas, P.L.; Becker, H.A. (Queen's Univ., Kingston, Ontario). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The abundance of coal in combination with rising energy costs has lead to a renewed interest in coal as an energy source and a chemical feedstock. This work describes the simulation of the FBC-based steam heating plant at Canadian Forces Base (CFB) Summerside, Prince Edward Island, Canada, built by Foster Wheeler Canada in 1981. The Advanced System for Process Engineering (ASPEN) is used as the simulation model, and currently yields heat and material balances, predicts sizes and costs of major process equipment, and performs an economic analysis of the plant. Information from the simulator will enable the user to predict the operability of the plant and the cost of the steam product as a function of coal analysis, coal prices, and plant operating conditions. Results include a comparison of ASPEN predictions with actual plant operating data. The plant produces 38,372.0-lb/hr saturated steam at a pressure of 120-psig. The coal and limestone feed rates are 4200- and 1153-lb/hr, respectively. The total capital investment is estimated to be $20.7 million with a yearly operating cost of $10.58 million/yr. If the plant was to be heated with electricity, the yearly cost would be approximately $17.28 million/yr. Therefore, a savings of $6.7 million/yr over the plant life of 25 years is indicated. The major advantage of the FBC unit, however, is its ability to burn the high-sulfur, high-ash coals that are abundant in the area.

7429 (EPRI-CS—5186, pp 29.1-29.10) **Microprocessor-based control system for Colorado-Ute's circulating fluidized-bed demonstration project.** Melvin, R.H. (Colorado-Ute Electric Association, Inc., Montrose). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The advanced power plant of today represents an evolving technology quite different from that of only a few years ago. An example of this evolution can be seen in Colorado-Ute's circulating fluidized-bed (CFB) boiler demonstration project at Nucla. In a parallel evolution, control technology has grown at such a rate that today extensive computing power is available through the use of microchips, which are the backbone of distributed microprocessor-based control systems. The challenge, then, has been to tap this resource and tailor it to the requirements of the Nucla project. In the past, overall plant control systems often had to be designed around hardware limitations and in some cases required using equipment from several vendors, or at the very minimum several different lines of equipment from the same vendor. This paper describes Colorado-Ute's approach to utilizing the power and flexibility of the distributed microprocessor technology, and discusses why this approach was perceived to be the most logical for the project.

7430 (EPRI-CS—5186, pp 30.1-30.19) **Dynamic simulation of the Colorado-Ute circulating fluidized-bed demonstration plant.** Weber, D.S.; Dimenstein, D.M. (Philadelphia Electric Co., PA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

There are several advanced power plant technologies that are increasingly becoming attractive to electric utility companies, one of which is known as circulating fluidized bed (CFB). Before installation of such a system, however, it is important to understand the operating characteristics of a CFB plant. At the present time there is a general lack of operating experience from which to draw information, since no similar unit exists on the utility system and in most cases today the unit being constructed is one-of-a-kind. But beyond this, an understanding of the system will make possible the opportunity to implement better control systems and develop more correct operating procedures prior to plant startup. All of this is important because, of course, plant downtime is expensive. Toward this end, the Modular Modeling System (MMS) code developed by the Electric Power Research Institute (EPRI) was used in developing a dynamic mathematical model of a CFB plant. MMS consists of a library of developed process models such as pumps, valves, pipes, and heat exchangers. The user interconnects these modules, following a defined methodology, to create a system model. This paper presents one such application where dynamic simulation is being used to address the above needs.

7431 (EPRI-CS—5186, pp 32.1-32.34) **AFBC design evaluation using AFBTREE: integrated engineering and financial analysis.** Roughgarden, J.D.; Johnson, M.S. (Decision Focus Inc., Los Altos, CA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

AFBTREE is a family of EPRI software products designed to assist engineers in performing AFBC scoping studies, competitive bid evaluations, and design optimization studies. AFBVAL, the first of the AFBTREE programs, performs integrated engineering and financial evaluations at the unit level. Engineering computations yield sorbent performance, a mass balance, boiler efficiency, and annual consumption and production. Financial computations associated with the revenue requirements method yield cost, maintenance, and auxiliary power accounts, schedule opportunity costs (AFUDC), fixed cost carrying charges, and O & M, fuel, and consumables expenses. Sensitivity and scenario analysis capabilities are automated. Two examples are presented that demonstrate the benefits of using AFBVAL for project assessment. The first shows that design decisions based solely on boiler efficiency impacts are likely to be non-optimal in terms of net economic benefits. The second example illustrates AFBVAL's capability to determine the bottom-line costs and benefits of burning alternative fuels, an essential aspect of AFBC fuel flexibility analysis.

7432 (EPRI-CS—5186, pp 33.1-33.17) **Assessing the value of AFBC fuel flexibility.** Abrahamson, P.G. (Applied Decision Analysis, Inc., Menlo Park, CA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

This is a graphical presentation which shows the advantages of atmospheric fluidized bed combustion based on the fuel flexibility it enables. A technology that can respond to changes in fuel market conditions has a value that is not recognized in traditional economic analysis. This value can be quantified through explicit consideration of transportation costs, external market factors, regulations on mining and emissions, and effects on plant operation. This presentation tries to present illustrations that show these economic benefits.

7433 (EPRI-CS—5186, pp 34.1-34.10) **Monitoring the reliability of AFBC utility demonstration units.** Horton, M.; Tavoulareas, S. (Duke Power Co., Palo Alto, CA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The Electric Power Research Institute (EPRI) has developed a plan to monitor the reliability of atmospheric fluidized-bed combustion (AFBC) equipment at three utility AFBC demonstration units. Maintenance records and component reliability data will

be gathered in the development of a broad database that can be used to evaluate the performance of AFBC equipment and systems at each demonstration facility and at future AFBC plants. This database will include such information as the equipment nameplate data; time of initial startup; such failure data as cause, corrective action(s), and materials used; time equipment was returned to service; and man hours required for repairs. As such, it will provide a comprehensive equipment history that electric utilities can use in preventive maintenance programs as well as in the planning of future AFBC projects.

7434 (EPRI-CS—5186, pp 35.1-35.26) **Determining the technical feasibility of AFBC retrofits.** Gendreau, R.J. (Stone & Webster Engineering Corp., Boston, MA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

It wasn't until the late 1960s that concentrated work on atmospheric fluidized-bed combustion (AFBC) was began in the US. Today, many operating AFBC systems have clearly demonstrated not only this capability, but also other major advantages that these systems have over conventional boiler technologies, including the following: the ability to burn a wide range of fuels, including low-grade coal and waste; the production of low levels of oxides of nitrogen (NO/sub x/); waste material is a single, dry solid that is relatively easy to handle and is not harmful to the environment. In this paper, AFBC will be used to refer to atmospheric fluidized-bed combustion systems in general, while AFB and CFB will be used to refer specifically to bubbling fluidized-bed designs and circulating fluidized bed designs, respectively. Applications for fluidized-bed systems can be broken down into retrofits, repowering, and new plants. A retrofit consists of adding a fluidized bed onto an existing furnace and making all necessary changes and additions to the furnace and balance-of-plant (BOP) systems and equipment. In the US examples of this approach include the Northern States Power (NSP) French Island wood-burning AFBC retrofit project, and NSP's 130-MWe Black Dog unit 2 AFBC retrofit project. Although the focus of this paper is on the retrofit option, another approach that may be beneficial in some applications is repowering. To repower requires the building of a new fluidized-bed unit and auxiliary systems and the provision of the equipment needed to produce steam in an existing turbine plant. The unit can be located in a new boiler house, or it may be possible in some cases to install the new boiler in the space previously occupied by the old boiler.

7435 (EPRI-CS—5186, pp 36.1-36.12) **Selection factors for fluidized-bed boilers: three case studies.** McComas, M.W.; Gould, G.L.; Thies, L.J. (Burns & McDonnel's Engineering, Kansas City, MO). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Burns & McDonnel has recently been involved with three projects that considered alternative steam production technologies, including a public university in need of additional capacity to meet the needs of an expanding campus, a small power producer desiring to use biomass as a fuel for a new power generating facility, and a Midwest grain processor seeking to reduce energy costs. These projects represented three different types of owners with separate reasons for considering new steam production facilities. Although each project utilized different evaluation criteria, the end result of each was the selection of the circulating fluidized-bed (CFB) boiler.

7436 **(PB—87-231569/XAB) Mitsubishi Electric Advance, Vol. 39, June 1987. Power-System Edition.** (Mitsubishi Electric Corp., Tokyo (Japan)). 1987. 37p. NTIS, PC E03/MF A01.

This issue contains technical reports on: Mitsubishi advanced power systems; Instrumentation, control, and electrical systems for nuclear power plants; Thermal power plants; A total digital system for hydraulic power plants; New technologies for power systems; Power transformers; Gas-insulated switchgear; Advanced power-system control and protection systems; Automation technology for power-distribution systems; Wavelength switching in GaAs single-quantum-well lasers; and A scandium-oxide dispersed cathode for CRTs.

## 2002 Environmental Control Technology

*REFER ALSO TO CITATION(S) 7144, 7147, 7181, 7183, 7202, 7417, 7436*

7437 (EPRI-CS—5186, pp 12.1-12.17) **Utility scale AFBC projects - 1986 update.** Ehrlich, S.; Howe, W.; Lawrence, C.; Tavoulareas, S. Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Atmospheric fluidized-bed combustion (AFBC) offers several potential advantages over a conventional pulverized-coal steam generator, particularly when a conventional boiler would have to be equipped with a flue gas desulfurization system. AFBC can meet the sulfur and nitrogen oxide emission regulations without add-on emission control equipment. Low coal-combustion temperatures in the AFBC eliminate slagging problems as well as low-NO/sub x/ levels. The major benefit of the low combustion temperature in an AFBC is that it permits a wide range of fuels to be fired in the same combustor. The Electric Power Research Institute (EPRI) is participating in three utility-scale AFBC demonstration projects expected to start operation in 1986, 1987, and 1988. The three units are being built by Northern States Power Company (NSP), Colorado-Ute Electric Association, and the Tennessee Valley Authority (TVA). Each project has unique characteristics (scope of supply, design configuration, fuel, location, starts per year, etc.) that make the three projects complementary. This report describes the development of AFBC technology, the three utility-scale AFBC demonstration plants, and the technical and economic information EPRI expects to derive from these projects.

7438 (EPRI-CS—5186, pp 20.1-20.19) **Demonstration test program of the 50-MWe AFBC boiler in Japan.** Nakabayashi, Y. (Electric Power Development Co., Ltd., Tokyo, Japan). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Now that coal is being reevaluated worldwide as an energy resource to be used in place of petroleum, research and development of the fluidized-bed combustion boiler (FBC) is one of the important themes in the field of coal utilization for electric utility and industrial use. It is expected that the FBC boiler will have the ability to fire various types of coal and also demonstrate the same pollutant performance (desulfurization and NO/sub x/ suppression in the bed) as that of conventional pulverized coal-fired boilers (PCF) with the wet flue gas desulfurization systems (FGD). The following four points are the main objectives for the development of the FBC boiler for utility use in Japan: (1) conform to the Japanese level of strict environmental control values, and be capable of reducing power generation cost as compared with the conventional PCF boiler plant; (2) be capable of efficiently firing the various types of coal imported into Japan; (3) have considerably reliability as a large-capacity power plant; and (4) have the ability to control the load equal to that of the intermediate-load thermal power plant. The feasibility studies on the 500-MWe plant as well as the 20-t/h pilot plant tests (equivalent to 5-MWe) have already been complet-

ed. This paper describes the demonstration program of the 50-MWe AFBC plant promoted by the Electric Power Development Co., Ltd. (EPDC), and partially funded by the Ministry of International Trade and Industry (MITI).

7439 **(PB—87-232120/XAB) Evaluation of rural air-quality simulation models. Addendum D: Paradise $SO_2$ data base.** Cox, W.M.; Rorex, H.W.; Moss, G.K.; Baldridge, E.W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jan 1987. 105p. (EPA—450/4-83/003D). NTIS, PC A06/MF A01.

See also Addendum C, PB—86-242757.

The addendum provides additional information regarding the performance of four rural air quality simulation models using $SO_2$ air quality and a modelers data base assembled for the Paradise Power Plant. The report contains numerous tabulations of each model's performance in terms of statistical measures recommended by the AMS. The four models evaluated included MPTER (EPA), PPSP (Martin Marietta Corp), MPSDM (ERT), and TEM-8A (Texas Air Control Board). Results from this evaluation were similar in many ways to those obtained for Clifty Creek, Muskingum River, and Kincaid. PPSP clearly over-predicted concentrations in almost every data category while MPSDM, MPTER, and TEM exhibited relatively small but detectable biases depending on averaging period and data category.

7440 **(PB—88-103031/XAB) EPA's (Environmental Protection Agency's) program for evaluation and demonstration of low-cost retrofit LIMB (Limestone Injection Multistage Burner) technology.** Stern, R.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Sep 1987. 22p. (EPA—600/D-87/267). NTIS, PC A03/MF A01.

This paper discusses program objectives, approaches, current status and results, future activities, and schedules for EPA's program for research and development, field evaluation, and demonstration of Limestone Injection Multistage Burner (LIMB) technology. Primary emphasis is on: (1) the full-scale demonstration being conducted on Ohio Edison's 104-MW wall-fired Edgewater Station Unit 4; (2) evaluation on a 50 million Btu/hr tangentially fired prototype nearing completion; (3) on-going field evaluation on Richmond Power and Light's 61-MW tangentially fired Whitewater Valley Generating Station Unit 2. The new program for demonstration on Virginia Electric Power's 180-MW tangentially fired Yorktown II Plant is also described. The LIMB process is based on injecting dry sorbents into the boiler for direct capture of $SO_2$ from the combustion gases. LIMB combines sorbent injection for $SO_2$ control with the use of low-NOx burners, in which staged combustion is utilized for NOx control.

7441 **Stoichiometry of ferrous nitrosyl complexes.** Littlejohn, D.; Chang, S.G. (Lawrence Berkeley Lab., M/S 70-110A, Applied Science Div., Univ. of California at Berkeley, Berkeley, CA 94720). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1232-1233(Jun 1987). Contract AC03-76SF00098.

The ferrous ion to nitric oxide ratio has been determined for the class of compounds Fe/sup II/(L)/sub x/(NO)/sub y/, where L = H/sub 2/O, citrate, IDA, NTA, and EDTA. All compounds studied were found to have a maximum ferrous ion to nitric oxide ratio of 1:1. In addition, the equilibrium constant for the binding of nitric oxide to Fe/sup II/(H/sub 2/O)/sub 6/ was determined to be 470 M/sup -1/ at pH 3 and 25°C. The compounds have been proposed as agents to aid in the removal of nitric oxide from power plant flue gas streams.

## 2003 Power Transmission And Distribution

7442 **(CONF-870516—10) Advanced techniques for detection of $SF_6$ by-products.** Sauers, I. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001726/JAW.

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

This group discussion on new diagnostic techniques covers the following papers: large-apparatus image delay lenses, optical measurements of currents in gases, techniques using electro-optic and magnetic-optic studies of electron beam discharges, fault prevention, infrared imaging systems for GIS, and diagnostic systems used in Japan. Main subject is $SF_6$ breakdown in gas-insulated power substations. (DLC)

7443 **(CONF-880102—2) A high-speed portable data acquisition system for distribution level monitoring.** Broadaway, E.R.; Wetherington, G.R. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE87014420/JAW.

From IEEE Power Engineering Society winter meeting; New York, NY, USA (31 Jan 1988).

A high-speed data-gathering system for feeder level monitoring on the Athens Automation and Control Experiment was utilized to assist in determining the effect of automated electric power distribution system actions. Funding for this experiment was provided by the US Department of Energy Office of Energy Storage and Distribution, with management by the Oak Ridge National Laboratory. The system was used to measure phenomena of millisecond duration at the distribution system level. The system is portable and features an aggregate data scan rate of 250 to 10,000 samples/s over 10 channels of input signals, with a resolution of 14 bits. Data are gathered over time periods varying from several seconds to as long as 5.5 hours. A specialized cabling configuration allows quick installation and easy interface to distribution level equipment. The system supports graphical presentation of acquired data via a graphics terminal to permit interpretation of results in the field. Off-line data analysis is performed on mainframe computers after transfer of data from magnetic tapes generated by the high-speed system. This system allows examination and interpretation of events typical of control actions such as capacitor switching, voltage regulation, load transfer, and load control on an electrical distribution system in a manner not possible with conventional substation or feeder level monitoring.

7444 **(N—87-30132) Optimizing the antenna system of a microwave space power station: Implications for the selection of operating power, frequency and antenna size.** Manning, R.M. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1987. 9p. (NASA-TM—100184; E—3761; NAS—1.15:100184). NTIS, PC A02/MF A01.

A design for a space power station that is to transmit power to the surface of a planet via high powered microwaves should commence with the optimum design of the transmitting and receiving antenna combination to be employed. Once one has assured that the desired amount of power has been transferred, one can, from the constraints imposed by such a design, taylor other parameters of the system such as antenna sizes and weights, power density in the planet's atmosphere (e.g., to avoid electrical breakdown), and frequency of operation. It is the purpose of this brief analysis to provide the working equations of such an optimized antenna system, and to give examples of their use. Related problems that should be analyzed in the future will then be discussed and a flow chart of the indicated order of priority presented. The analysis given here differs from previous work on this subject in that the development given will allow analytical expressions to be obtained for the relevant parameters. This is made possible by employing an approximation procedure to be given during the exposition.

# 21 NUCLEAR POWER PLANTS

*REFER ALSO TO CITATION(S) 7436, 8355*

## 2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

*REFER ALSO TO CITATION(S) 7446, 7464, 7470, 7471, 7472, 7479, 7484, 7485, 7486, 7493, 7496, 7498, 7502, 7504, 7506, 7508, 7509, 7517, 7520, 7521*

## 2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

*REFER ALSO TO CITATION(S) 7457, 7458, 7459, 7460, 7461, 7462, 7463, 7464, 7477, 7478, 7490, 7491, 7497, 7498, 7513, 7514, 7517, 7519, 7520, 7521*

7445 (GA-A—18763, pp 17, Paper 6) **Fission data on cable/connector components.** Cannon, S. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Cables and connectors removed from the Three Mile Island-2 Reactor (TMI-2) have been evaluated for mechanical, electrical, and physical changes following the loss-of-coolant accident (LOCA). It was found that the devices suffered outer jacket failures but retained functionality. Changes seen in specimen properties would not account for the readings obtained at TMI-2 following the LOCA. It is possible that electroiytic effects may have been responsible for the unreliable readings.

7446 (IAEA-TECDOC—429) **Reactor water chemistry relevant to coolant-cladding interaction.** (International Atomic Energy Agency, Vienna (Austria)). Sep 1987. 214p. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88700803/JAW.

The report is a summary of the work performed in a frame of a Coordinated Research Program organized by the IAEA and carried out from 1981 till 1986. It consists of a survey on our knowledge on coolant-cladding interaction: the basic phenomena, the relevant parameters, their control and the modelling techniques implemented for their assessment. Based upon the results of this Coordinated Research Program, the following topics are reviewed on the report: role of water chemistry in reliable operation of nuclear power plants; water chemistry specifications and their control; behaviour of fuel cladding materials; corrosion product behaviour and crud build-up in reactor circuits; modelling of corrosion product behaviour. This report should be of interest to water chemistry supervisors at the power plants, to experts in utility engineering departments, to fuel designers, to R and D institutes active in the field and to the consultants of these organizations. A separate abstract was prepared for each of the 3 papers included in the Annex of this document. Refs, figs, tabs.

7447 (IVO-A—01/87) **Thermal-hydraulics of the Loviisa reactor pressure vessel overcooling transients.** Tuomisto, Harri. (Imatran Voima Oy, Helsinki (Finland)). Jun 1987. 180p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751304/JAW.

In the Loviisa reactor pressure vessel safety analyses, the thermal-hydraulics of various overcooling transients has been evaluated to give pertinent initial data for fracture-mechanics calculations. The thermal-hydraulic simulations of the developed overcooling scenarios have been performed using best-estimate thermal-hydraulic computer codes. Experimental programs have been carried out to study phenomena related to natural circulation interruptions in the reactor coolant system. These experiments include buoyancy-induced phenomena such as thermal mixing and stratification of cold high-pressure safety injection water in the cold legs and the downcomer, and oscillations of the single-phase natural circulation. In the probabilistic pressurized thermal shock study, the Loviisa training simulator and the advanced system code RELAP5/MOD2 were utilized to simulate selected sequences. Flow stagnation cases were separately calculated with the REMIX computer program. The methods employed were assessed for these calculations against the plant data and own experiments.

7448 (IVO-A—02/87) **Application of the REMIX thermal mixing calculation program for the Loviisa reactor.** Kokkonen, I.; Tuomisto, H. (Imatran Voima Oy, Helsinki (Finland)). Aug 1987. 49p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751305/JAW.

The REMIX computer program has been validated to be used in the pressurized thermal shock study of the Loviisa reactor pressure vessel. The program has been verified against the data from the thermal and fluid mixing experiments. These experiments have been carried out in Imatran voima Oy to study thermal mixing of the high-pressure safety injection water in the Loviisa VVER-440 type pressurized water reactor. The verified REMIX-versions were applied to reactor calculations in the probabilistic pressurized thermal shock study of the Loviisa Plant.

## 2103 Power Reactors, Non-breeding, Graphite Moderated

*REFER ALSO TO CITATION(S) 7476, 7492, 7499, 7501, 7507, 7518*

7449 (CEGB-TPRD/B—0871/R87) **Radiological consequences of delaying the final dismantling of a Magnox nuclear power station.** Woollam, P.M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1987. 70p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751462/JAW.

The timing of the final dismantling process after shutdown and decommissioning of Magnox power stations will depend on balancing the need to reuse the site against the advantages of allowing residual radioactivity to decay. A delay of 130 years would reduce the dose commitment to dismantling staff as far as practicable and remove the need to depend on robotic systems. This in turn would lead to cost savings of about Pound 800M, at 1986 prices, totalled over all the CEGB's Magnox power. If final dismantling were to be delayed, it is intended that the residual reactor building would be maintained in a sealed, weathertight condition, and it is confidently expected that this will be achieved. This report investigates the consequences of any failure in this containment using, as a demonstration of the robustness of the radiological case for delay, some extreme scenarios in which the nuclear island is presumed to have collapsed. To demonstrate the robustness of the case for delay, the radiological consequences over a time period, which is roughly one order of magnitude both greater and smaller than the 130 y optimum are considered. The radiological consequences which might result, over a 1500 year period, from the leakage of radioactive materials from the reactor structure in the event that final dismantling were to be delayed are determined. Any engineering constraints which these radiological consequences might impose are discussed.

## 2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

*REFER ALSO TO CITATION(S) 7483, 7489, 7511, 7512*

## 2105 Power Reactors, Breeding

7450 **Control system for fluid heated steam generator.** Boland, J.F.; Koenig, J.F. (to Department of Energy, Washington, DC, USA). British Patent 2159641/A/. 4 Dec 1985. Priority date 29 May 1984, United States of America (USA), 7p. Patent Office, 25 Southampton Buildings, London, WC2A 1AY.

US priority 614507.

A control system for controlling the location of the nucleate-boiling region in a fluid heated steam generator comprises means for measuring the temperature gradient (change in temperature per unit length) of the heating fluid along the steam generator; means for determining a control variable in accordance with a predetermined function of temperature gradients and for generating a control signal in response thereto; and means for adjusting the feedwater flow rate in accordance with the control signal.

### 2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

*REFER ALSO TO CITATION(S) 7303, 7391*

### 2107 Regulation And Licensing

*REFER ALSO TO CITATION(S) 7516*

7451 **(NUREG—0540-Vol.9-No.9) Title list of documents made publicly available, September 1-30, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Nov 1987. 492p. NTIS, PC A21/MF A01 - GPO. Order Number TI88900166/JAW.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference to Principal Documents.

### 2108 Economics

*REFER ALSO TO CITATION(S) 7474*

7452 (INIS-BR—897, pp 71) **Electrical energy independence in Brazil and the role of nuclear energy.** Nascimento, I.C. do; Moreira, J.R. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

## 22 NUCLEAR REACTOR TECHNOLOGY

### 2202 Components And Accessories

7453 **(EPRI-NP—5513-SR) Large-scale soil-structure interaction: Special report.** Tang, H.T. (Electric Power Research Inst., Palo Alto, CA (USA)). Nov 1987. 98p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920089/JAW.

Soil-structure interaction (SSI) models are used to simulate the effects of earthquakes on the foundations and buildings of nuclear plants. Because of a lack of data accumulated during actual earthquakes, NRC's Standard Review Plan (SRP) 3.7.2 has specified a conservative enveloping of response predictions from existing models. This conservatism impacts the design requirements of the entire nuclear power plant, including its containment and internal components. In cooperation with the Taiwan Power Company (Taipower), the Electric Power Research Institute (EPRI) is conducting field experiments in Lotung, Taiwan, a seismically active area, to gather data for the development of more realistic SSI models for regulators and nuclear utilities.

### 2203 Fuel Elements

*REFER ALSO TO CITATION(S) 7522*

### 2204 Control Systems

*REFER ALSO TO CITATION(S) 7522*

7454 **(AAEC/E—658) Predicted HIFAR fuel element temperatures for postulated loss-of-coolant accidents.** Green, W.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700781/JAW.

A two-dimensional theoretical heat transfer model of a HIFAR Mark IV/Va fuel element has been developed and validated by comparing predicted thermal performances with experimental temperature responses obtained from irradiated fuel elements during simulated accident conditions. Full details of the model's development and its verification have been reported elsewhere. In this report, the model has been further used to ascertain acceptable limits of fuel element decay power for the start of two specific LOCAs which have been identified by the Regulatory Bureau of the AAEC. For a single fuel element which is positioned within a fuel load/unload flask and is not subjected to any forced convective air cooling, the model indicates that fission product decay powers must not exceed 1.86 kW if fuel surface temperatures are not to exceed 450 deg C. In the case of a HIFAR core LOCA in which the complete inventory of heavy water is lost, it is calculated that the maximum fission product decay power of a central element must not exceed 1.1 kW if fuel surface temperatures are not to exceed 450 deg C anywhere in the core.

7455 **(ZJE—276) Linear step drive.** Haniger, L.; Elger, R.; Kocandrle, L.; Zdebor, J. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700832/JAW.

A linear step drive is described developed in Czechoslovak-Soviet cooperation and intended for driving WWER-1000 control rods. The functional principle is explained of the motor and the mechanical and electrical parts of the drive, power control, and the indicator of position are described. The motor has latches situated in the reactor at a distance of 3 m from magnetic armatures, it has a low structural height above the reactor cover, which suggests its suitability for seismic localities. Its magnetic circuits use counterpoles; the mechanical shocks at the completion of each step are damped using special design features. The position indicator is of a special design and evaluates motor position within +-1% of total travel. A drive diagram and the flow chart of both the control electronics and the position indicator are presented. (author) 4 figs.

### 2205 Environmental Aspects

*REFER ALSO TO CITATION(S) 7523, 8160*

### 2206 Research, Test, And Experimental Reactors

*REFER ALSO TO CITATION(S) 8165*

7456 **(EIR—634) Safety characteristics of small heat producing reactors.** Seifritz, W. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Oct 1987. 5p. (In German). NTIS (US Sales Only), PC A02/MF A01 - Also published in Atomwirtsch., Atomtech. (Aug-Sep 1987) v. 32(8-9) p. 437-439.. Order Number DE88700791/JAW.

The primary objectives of protection in nuclear power plants are the possibility to shut the reactor down in case of emergency and keep it subcritical in the long run, the existence of a heat sink for post-decay heat removal in order to avoid overheating, let alone core meltdown, and the containment of radioactivity within the barriers designed for this purpose, thus preventing significant activity release. In principle, these objectives can be met in various ways, namely by active, passive or inherent technical safeguards systems. In practice, a mixture of these approaches is employed in almost all cases. What matters in the end is the assessment of the overall concept, not of some outstanding feature. Inherent characteristics are easier to achieve in small reactors. However, also in this case, inherent safety does not mean absolute safety. If inherent safety characteristics were all encompassing, they would have to include self-healing effects. However, inanimate matter is incapable of such self-organization. Consequently, inherent characteristics in nuclear technology by definition should include the increased use of dissipative processes in the thermal part of the plant.

## 2207 Plutonium And Isotope Production Reactors

*REFER ALSO TO CITATION(S) 8186*

## 2209 Reactor Safety

*REFER ALSO TO CITATION(S) 7242, 7243, 7244, 8160, 8355*

7457 (CONF-871018—Vol.1, pp I.35-I.42) **Shippingport Station Decommissioning Project: an overview and status report.** Schreiber, J.J. (Dept. of Energy, Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

An overview and current status of the Shippingport Station Decommissioning Project (SSDP) are presented. The Shippingport Atomic Power Station is the first commercial-size nuclear power plant to undergo decommissioning in the US. The project is planned to demonstrate decommissioning operations within an environment of current industry practice; e.g., dismantlement and other SSDP operational procedures are based upon current construction/maintenance/demolition practices.

7458 (CONF-871018—Vol.1, pp II.1-II.6) **Summary of lessons learned at the Shippingport Station Decommissioning Project (SSDP).** Crimi, F.P.; Mullee, G.R. (General Electric Co., Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Shippingport Atomic Power Station consists of the nuclear steam supply system and associated radioactive waste processing systems, which are owned by the US Department of Energy (DOE), and the turbine generator and balance of plant, which is owned by the Duquesne Light Company (DLC). The station is located at Shippingport, Pennsylvania on seven acres of land leased by the US DOE from the Duquesne Light Company. The Shippingport Station Decommissioning Project (SSDP) is being managed by the General Electric Company for the US DOE. The lessons learned from a management perspective during the performance of the SSDP are described. The lessons learned are presented in a chronological sequence during the life of the project up to the present time. The careful analysis of the lessons learned at SSDP and the implementation of corresponding actions have contributed toward improving the effectiveness of the SSDP as time progresses. The lessons learned should be helpful in planning future decommissioning projects.

7459 (CONF-871018—Vol.1, pp II.7-II.23) **Removal of Shippingport Station primary system components and piping.** LaGuardia, T.S.; Lipsett, S.M. 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The dismantling workscope for the Shippingport Station Decommissioning Project was divided into subtasks to permit the work to be subcontracted to the maximum extent practicable. Major subtasks were identified and described by Activity specifications which could then be grouped into logical work packages to be put out for bid. Two of the largest dismantling work packages, removal of piping and components, were grouped together and designated as Activity Specifications 4 and 5. TLG Services, Inc. and Cleveland Wrecking Company formed a Joint Venture to perform this work during a two-year period at a cost of approximately $7 million. The major portions of this dismantling workscope are described. The primary system components within this workscope consist of the stainless steel reactor coolant piping, check valves, reactor coolant pumps, steam generators, and reactor purification demineralizers and coolers. The work performed, the heavy rigging preparations and procedures, the cutting tools used, component draining/capping techniques to prevent spills, contamination containment, airborne control techniques, and lessons learned during the removal of these primary system components are described. Summaries of crew size and composition, labor hours, duration hours and radiation exposure to workers are provided and discussed briefly. The successful completion of this work is evidence of the engineering, planning, equipment, materials and labor pool available to remove large, radioactively contaminated components safely. This experience will help decommissioning planners to prepare for the removal of reactor components in future decommissioning.

7460 (CONF-871018—Vol.1, pp II.24-II.30) **Scheduling for decommissioning projects.** Podmajersky, O.E. (General Electric Co., Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Project Scheduling system being employed by the Decommissioning Operations Contractor at the Shippingport Station Decommissioning Project (SSDP) is described. Results from the planning system show that the project continues to achieve its cost and schedule goals. Initial technical, cost, and schedule baseline guidance was issued for the project in a Decommissioning Plan in September 1983. An integrated cost and schedule control system (C/SCS) which uses the concept of earned value for measurement of performance was instituted in accordance with DOE orders. The schedule and cost variances generated by the C/SCS system are used to confirm the management's assessment of project status. The types of schedules and tools used on the SSDP project to plan and monitor the work are described, and factors that are unique to a decommissioning project that make scheduling critical to the achievement of the project's goals are identified.

7461 (CONF-871018—Vol.1, pp II.31-II.47) **Reactor pressure vessel preparation for shipment and burial.** Kea, K.I. Jr. (General Electric Co., Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Shippingport Station Decommissioning Project is a Department of Energy sponsored project to dismantle the Shippingport Atomic Power Station and return the government leased property in a radiologically safe condition to its owner, the Duquesne Light Company. All radioactive material including the reactor pressure vessel will be removed from the station and transported by barge to the Government-owned Hanford Reservation in Richland, Washington for burial. The Shippingport Station Decommissioning Project is being managed by the General Electric Company for the US Department of Energy. The preparation of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) for removal, barge shipment and burial are discussed. The preparation of the RPV/NST package, to be outlined, results in a monolithic package which more than meets the requirements for a strong-tight container for transport of low specific activity material and is also expected to be adequate for the analysis and scenarios required for a Type B Container. Radiological dose analyses performed on the RPV/NST package for different postulated accident situations demonstrated that radionuclide releases would be insignificant. The description, rationale, engineering considerations and preparation process are described.

7462 (CONF-871018—Vol.1, pp II.48-II.64) **Establishment of criteria for the unconditional release of the Shippingport Atomic Power Station site.** Eger, K.J.; Giordano, R.J.; Gardner, D.L.; Galgoul, M.J. (General Electric Co., Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Shippingport Atomic Power Station is the first major remedial action project where the residual radioactivity will not be uranium daughter products. Therefore, new site specific limits have to be specified beyond those generic promulgated values in the US Department of Energy Guidelines for Residual Radioactivity at ... Surplus Facilities Management Program Sites. The key elements have led to the specification of the site release criteria for the Shippingport site are described. These elements include the initial site characterization, the radiological conditions found, and the application of the DOE document A Manual for Implementing Residual Radioactivity Guideline. The direct recommendation of release limits is discussed as an alternate to basing the limits on a cost bene-

fit basis. However, the study shows that both the direct recommendation and the cost benefit analysis were important in defining the final release criteria. Finally, the release limits are defined and a proposed plan for implementing them is presented. The work emphasizes the development of a procedure which will (1) consider the cost of postulated remedial actions and (2) employ an appropriate number of scenarios to demonstrate compliance with applicable limits and the ALARA philosophy.

7463 (CONF-871018—Vol.1, pp II.65-II.82) **Practical radiation, contamination and asbestos control techniques for decommissioning.** Giordano, R.J.; Gardner, D.L.; Taylor, C.A. (General Electric Co., Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Many of the needs for the control of radioactive material and asbestos during a decommissioning project are unique. First, there are the complications which arise when the two hazards are encountered simultaneously. Secondly, there are opportunities that arise because of the unique characteristics of a decommissioning project. There is additional latitude in the choice of work procedures since the end product is the ultimate disposal of the facility. The experiences and lessons learned as these unique needs were encountered during the decommissioning of the Shippingport Atomic Power Station are discussed. The experience and lessons learned from work with radioactivity and asbestos together include discussions of the personnel and material access control, and the development of work and clearance procedures. Procedures especially adaptable to decommissioning were used to control contamination and airborne radioactivity during thermal cutting. Similar ventilation control innovations helped reduce both work time and personal exposure. The practical experience obtained in these areas is provided to aid in minimizing future technical problems, exposure and costs.

7464 (CONF-871018—Vol.1, pp II.83-II.96) **Decommissioning policy in Sweden.** Bergman, C.; Boge, R.; Snihs, J.O. (National Institute of Radiation Protection, Stockholm, Sweden). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In Sweden the nuclear power program is, according to a parliamentary decision, limited to twelve power producing reactors. The last reactor shall be taken out of service no later than the year 2010. As a result of the Chernobyl accident the program for taking the reactors out of service will be accelerated. The first approach by the Swedish authorities to formulate a decommissioning policy is discussed. It is not the final policy document but it discusses the principal questions from the special Swedish viewpoint.

7465 (CONF-871018—Vol.1, pp II.97-II.106) **Decommissioning costs: coal compared to nuclear.** Williams, D.H. (Arkansas Power & Light Co., Little Rock). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A comparison is made of the cost of decommissioning nuclear power plants and the cost of decommissioning coal-fired power plants. The comparison examines assumptions and labor factors and makes adjustments to enhance the similarity of the bases for selected previous cost estimates before comparing results of the cost estimates. Results indicate that the decommissioning cost of a large coal-fired power plant can be expected to be similar, on a dollar per megawatt basis, to that for a nuclear power plant.

7466 (CONF-871018—Vol.1, pp II.107-II.121) **Exemption limits for the recycling of materials from the dismantling of nuclear installations.** Chapuis, A.M.; Guetat, P.; Garbay, H. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Present regulations are not adequate for recycling or disposal of large quantities of waste from dismantled nuclear installations. Exemption limits may be set for particular kinds of materials normally produced during operation and dismantling. Exemption activity limits are based on dose levels and take into account the total mass of expected waste and all the possibilities of exposure. Case-by-case authorization procedures would only then be necessary for materials not treated by the exemption procedure or for materials with activities higher than the exemption limits. Exemption limits for steel have been evaluated for some radionuclides. This evaluation is based on usual industrial practices and working condition measurements and leads to mass and surface activity limits.

7467 (CONF-871018—Vol.1, pp II.122-II.131) **HPS/ANSI Health Physics Guide.** Shapiro, j. (Harvard Univ., Cambridge, MA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The recently approved standard of the Health Physics Society Standards Committee on surface radioactivity guides for materials, equipment and facilities to be released for uncontrolled use is discussed. The comments received by the committee on the limits and measurement methods are reviewed. Major topics include the limits for total alpha radioactivity, the reduction in the limits for natural uranium and thorium, the distinction between fixed and loose radioactivity, and hazard analyses relating to the limits.

7468 (CONF-871018—Vol.1, pp II.145-II.159) **Impact of decommissioning on electricity generation costs.** Crijns, M.J.; Vira, J. (OECD Nuclear Energy Agency, Paris, France). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

By definition, the levelized decommissioning cost is the weighted average cost that should be charged for each unit of electricity produced through the lifetime of the facility, to precisely cover all the costs that the decommissioning of the facility give rise to. Although the mode in which decommissioning costs enter the electricity rates depends on utility and regulatory practices, the levelization offers a consistent means for estimating the cost impact of decommissioning. An international group of experts, called together under the auspices of the OECD Nuclear Energy Agency (NEA), has prepared estimates on levelized decommissioning costs for nuclear power plants, starting from the cost information provided by some of its Member countries. Three basic strategies for decommissioning were considered, including immediate dismantling and two strategies for deferred dismantling. The Working Group calculated the levelized decommissioning costs for several assumptions on discount rates and reactor lifetimes. The calculations showed that decommissioning has a very small impact on electricity generation cost of a large nuclear power plant. The uncertainties in cost estimates, applicable interest rates or facility operating lifetimes are large but still unlikely to significantly affect this conclusion.

7469 (CONF-871018—Vol.1, pp III.1-III.17) **UKAEA research program for the decommissioning of WAGR and other radioactive facilities in the UK.** Thomas, P.J.; Williams, J. (Windscale Nuclear Labs., Seascale, England). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The United Kingdom Atomic Energy Authority (UKAEA) was strongly involved in the early development of nuclear power, and accordingly has a number of prototype plants that require decommissioning in the near future. It is appropriate that it should now take a leading role in the development of the technology needed to decommission nuclear facilities, and apply that technology to prototype decommissioning projects. The development program ongoing within the UKAEA is outlined.

7470 (CONF-871018—Vol.1, pp III.18-III.30) **Present status of JPDR decommissioning program.** Ishikawa, M.; Kawasaki, M.; Yokota, M; Ezure, H.; Hoshi, T.; Tanaka, M. (Japan Atomic Energy Research Institute, Ibaraki-ken). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

JAERI has been developing decommissioning technologies to dismantle the Japan Power Demonstration Reactor (JPDR) since 1981. The technology development has almost been completed and final check-out of the disassembly and demolition systems such as underwater plasma arc cutting and arc saw cutting were conducted to confirm the required performance. The actual JPDR decommissioning has started on December 4, 1986 according to the detailed decommissioning plan evaluated by the technical design study. The present status of the JPDR decommissioning program and the results of the evaluation study are described.

7471 (CONF-871018—Vol.1, pp III.31-III.49) **Decommissioning of Nuclear Power Plant Gundremmingen Unit A.** Mies, H.P.; Stang, W. (Kernkraftwerke Gundremmingen Betriebsgesellschaft mbH, West Germany). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Several nuclear power plants of the first generation have finished the nuclear life and retired in the status of decommissioning. In 1980 this significant milestone was settled for the nuclear power station KRB A. The reasons are quite similar for the international sister plants with the same status. The following phase of planning and evaluating a reasonable concept of decommissioning guided to the dismantling of unused systems in the turbine building. The experiences of dismantling, disassembling, decontamination and surveying measurement resulting from the treatment of 3000 tons materials released from the controlled area is described. The recycling of carbon steel for the production of waste containers made of cast iron is an important technique to reduce waste volume and has been performed with 1000 tons of steel scrap which is explained. Finally, an outlook towards the intended decommissioning steps in the reactor building is given.

7472 (CONF-871018—Vol.1, pp III.77-III.89) **Management of waste from the JPDR decommissioning.** Hoshi, T.; Seiki, Y.; Kato, K. (Japan Atomic Energy Research Institute, Ibarakai-ken). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Management of waste from dismantlement of a nuclear facility is a great concern because a large amount of radioactive waste arises in a short period. Radioactive solid waste of 4000 tons is estimated to be generated by the dismantlement of the JPDR facilities and will be disposed in such manners as storage and burial in accordance with their kinds of materials and activity level. Radioactive waste shall be managed under the regulatory laws. The regulations for the radioactive waste in Japan and the concepts of waste management of the JPDR decommissioning are described.

7473 (CONF-871018—Vol.1, pp III.90-III.100) **Treatment of waste metals from decommissioning.** Hempelmann, W. (Kernforschungszentrum Karlsruhe GmbH, West Germany). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Decommissioning and demolishing nuclear installations produces not only rubbish and secondary waste but, above all, metal components. All these types of waste are treated so that a maximum in volume reduction is achieved. In the first instance, this objective can be met by safely recycling or re-using waste material in nuclear facilities. The boundary conditions under which this is possible in the Federal Republic of Germany, and the techniques employed, are outlined. Another method applied successfully is melting of the waste metals for re-use or waste minimization. All waste for which neither technique can be applied is compacted under high pressure or stored in a repository without previous treatment, but solidified in cement mortar or other fillers. A survey is given of the waste generated to date in the Federal Republic of Germany from decommissioning and repair of nuclear reactors. The methods of treatment and the quantities of individual waste streams are indicated as far as possible. The types of treatment available can be evaluated only in the light of existing legal boundary conditions. These conditions are likely to become tighter in the Federal Republic. The expected impact on the work at KfK of this development is described.

7474 (CONF-871018—Vol.1, pp III.100-III.114) **Recycle and reuse of components arising from decommissioning nuclear installations: an overview.** Stearn, S.M. (HM Inspectorate of Pollution, London, England). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Recycling offers savings in both acquiring new materials and disposing of old. But this must be set against the associated economic, social and administrative costs. There is considerable experience of the problems involved and research is in hand to expand the authors understanding of these. Materials may be recycled within the nuclear industry only if there is a ready use for it. Release for unrestricted use depends on the existence of suitable criteria and a means to assure compliance with them. The interaction between these two factors could be a deciding factor. Work is in hand to prepare workable release criteria based on a dose to the public of not more than 10 microsieverts, and a figure of 1 Bq/gm is proposed. Quality assurance will be important in any recycling program. Public acceptance is crucial and unrestricted release must not operate so as to jeopardize this.

7475 (CONF-871018—Vol.1, pp III.115-III.127) **Results of metallic waste treatment by melting.** Sappok, M. (Siempelkamp Giesserei GmbH & Co., Krefeld, West Germany). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The idea of melting contaminated metallic waste coming from decommissioning or backfitting was born in 1981. In several papers the procedure was described in detail. Up to now about 1000 tons of metallic waste have been melted and recycled. Melting is accomplished by: cutting the material and filling into 200 l-drums; charging the material into the furnace using a special developed charging device; melting in an induction furnace under low pressure by tight enclosure of the melting bath; and keeping low pressure using a filter system, which filters all evading radioactive aerosols coming from the melt. To be able to melt in this special manner several licenses had to be achieved by the German authorities. The results of ten melting periods, where in total 300 tons of material was melted is reported. The results show the behavior of radionuclides during melting, so especially Co, Ag and Fe stay in the melt, while Cs, Zn and other nuclides leave the melt in total and can be found in the slag and the filter dust. The results give a good knowledge about the process. One of the most important points within this project was to determine the quantity of secondary waste, which was achieved by melting. It was found, that it depends on the quality of material, e.g., carbon steel or stainless steel and on the quantity of impurities like oil, rubber, paint and others. In general, a quantity of app. 3-5% of secondary waste was found.

7476 (CONF-871018—Vol.1, pp III.128-III.147) **Development of a large container for WAGR decommissioning wastes.** Thomas, P.J.; Wakefield, J.R. (Windscale Nuclear Labs., Seascale, England). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Windscale Advanced Gas-Cooled Reactor (WAGR) was built as a 100 MW prototype for the projected commercial nuclear power plants that came on stream in the 1970's. After 18 years operation at high load factor, the reactor was shut-down and the decision was made to decommission the plant to Stage 3, i.e., complete dismantling and return of the site to a green field. This has involved the UKAEA in an extensive program of development work. One of the key elements in this program is the production of an acceptable container for the Intermediate Level Waste formed by the irradiation of reactor materials. The container is required to meet a number of Regulatory standards both national and international. These cover handling and storage on the Windscale site, transport to the depository by road or rail and ultimately the engi-

neering needs of the depository itself. Experimental tests and mathematical analyses have been carried out to meet these needs. The final documentation which is almost complete will cover all aspects of design, testing and performance of the container and this paper is a report on the current status of the program.

7477 (CONF-871018—Vol.1, pp III.160-III.171) **Asbestos removal in Shippingport Decommissioning Project.** Jones, B.; Hendrickson, D. (International Technology Corp., Knoxville, TN). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Shippingport Station Decommissioning Project (SSDP) is being performed under contract to the DOE by the General Electric Company and its integrated subcontractor, MK-Ferguson Company, as the Decommissioning Operations Contractor (DOC). During the planning of this project, it was found that asbestos was the primary insulating material which was used on the nuclear steam supply system and the plant heating system. The original decommissioning plan required that each subcontractor remove the asbestos from the particular component(s) they had to remove. However, since removal of the radioactivity-contaminated asbestos would require special procedures and worker training, the original decommissioning plan was modified so that a single subcontractor removed all of the asbestos prior to other decommissioning tasks. IT Corporation was selected as the asbestos removal subcontractor. Their approach to the project is described.

7478 (CONF-871018—Vol.1, pp III.172-III.175) **Shippingport Station Decommissioning Project Technology Transfer Program.** Broom, C.A.; McKernan, M.L. (Westinghouse-Hanford Co., Shippingport, PA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Shippingport Station Decommissioning Project (SSDP) Technology Transfer Program is described. The program was established to ensure that project information is adequately documented and subsequently made available for future decommissioning use.

7479 (CONF-871018—Vol.1, pp III.201-III.209) **TA-2 Water Boiler Reactor (Phase I) decommissioning: resolving ground water interference during outdoor component removal and soil decontamination.** Elder, J.C. (Los Alamos National Lab., NM). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Extensive ground water was encountered in excavations as structures, pipe, and soil contaminated with Cs-137 were removed during the outdoor phase (Phase I) of the TA-2 Water Boiler Reactor decommissioning. Because it was imperative to avoid releasing contamination to a nearby surface stream, a relatively simple and effective method was employed to confine contaminated soil and water. The method of confinement involved pumping or scooping large quantities of contaminated soil and water to secondary pits above the level of ground water interference. These pits served as holding tanks/natural filters because high soil pH in the area enhanced attachment of Cs-137 to soil particles. Water seeped out of the secondary pits, leaving contaminated soil behind to be easily scraped from the surfaces of pit. This method and stabilization techniques are described. Stabilization and revegetation of the area, complemented by a long-term environmental surveillance program, has resulted in successful closure, although total removal of all contamination was not possible.

7480 (CONF-871018—Vol.1, pp III.293-III.306) **Utility perspective regarding nuclear power plant decommissioning.** Levy, L.H. (Northeast Utilities, Hartford, CT). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Nuclear plant decommissioning has become an important public issue over the past several years mainly due to increasing cost estimates and publicity from the media concerning nuclear energy. From the nuclear utility perspective, it is of utmost importance that they are allowed to recover from their customers enough revenue that will adequately cover the expense of decommissioning their nuclear plant by the time of retirement. A major hindrance to this recovery is the $100 million certification amount identified in the proposed Nuclear Regulatory Commission (NRC) Rule on Decommissioning. Current experience with site-specific studies of large scale nuclear power plants have shown the costs to be substantially higher. The Rule, therefore, should encourage the use of site-specific studies in lieu of the $100 million generic certification amount which can, and has been used by regulators as a ceiling on rate recoveries for decommissioning. Another important issue is whether the technology available today is sufficient to dismantle a large commercial nuclear plant. Experience from Elk River and Shippingport, as well as operating plant maintenance activities such as steam generator replacements, thermal shield removals, and reactor coolant piping replacements, have proven that the technology is more than adequate to handle a large nuclear plant dismantlement. These issues as well as NRC decommissioning regulations, decommissioning funding methods, and cost estimates are discussed.

7481 (CONF-871018—Vol.1, pp III.307-III.313) **Public attitudes toward nuclear power plant decommissioning.** Lough, W.T. (State Corp. Commission, Richmond, VA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A public workshop was conducted with a group of citizens to obtain the concerns and preferences of the group with respect to decommissioning. Seventeen concerns about decommissioning were identified and prioritized. The participants were most concerned about the potential health and safety effects from decommissioning. The potential impacts from the lost tax base and loss of employment were also rated highly. The estimated increase in electric utility rates was not a major concern. The participants were split fairly evenly on preferences about the methods of decommissioning. However, nine of the ten participants preferred power plant life extension over decommissioning by any method. Finally, the participants were given an evaluation questionnaire about the workshop. In general, they concluded that the process was effective, and they felt like they were a part of the Commission's planning process.

7482 (CONF-871018—Vol.1, pp III.314-III.323) **Multicriteria decision aid for evaluating nuclear power plant decommissioning.** Lough, W.T.; Johnson, W.R. (State Corp. Commission, Richmond, VA). 1987. NTIS, PC A 24. Order Number DE87012821/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Electric utilities and public service commissions have not taken full advantage of the many proven techniques available for evaluating complex technological issues. A case in point involves the selection of a specific method for decommissioning of nuclear power plants. A multicriteria decision-aiding technique, decision analysis, is introduced and applied to the decommissioning issue.

7483 (CONF-871018—Vol.2, pp IV.1-IV.7) **Decommissioning of Gentilly-1 - Canada.** Gupta, B. (Atomic Energy of Canada Ltd., Montreal, Quebec). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Canada's 250 MW(e) Gentilly-1 station went into service in 1971 in the Province of Quebec, Canada, and produced electricity intermittently until 1979. Since April 1986, the station has been decommissioned to a Static State following a two-year, 25 million dollars (Canadian) project. Access to the reactor building has been permanently shut off except for one airlock that can be made operable for periodic inspection. Systems inside the reactor building have been isolated and sealed. All radioactive materials and components inside the service building have been removed, the area decontaminated and released to the local utility Hydro-Quebec for a full scale simulator training center. Spent fuel has been put in interim on-site storage inside concrete canisters. The spent fuel bay has been decontaminated, and a slab poured on top of it.

7484 (CONF-871018—Vol.2, pp IV.86-IV.100) **Decontamination studies related to Garigliano BWR decommissioning.** Bregani, F.; Garofalo, A. (ENEL, Milan, Italy). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The Garigliano BWR is a 160 MWe power plant which operated from 1964 to 1978. In 1982 the ENEL Board of Directors declared it definitively out-of-service. Specific studies were started to select the best decommissioning alternatives. A feasibility study on dismantling and decontamination of all the building components was performed in preparation for decommissioning of the turbine building in a few years. Specific experimental activities were also started specifically in the decontamination field. A program which deals with the dismantling and decontamination of the tube bundle of a feed-water preheater is the most impor ant and significant task. The aim of this research is to decontaminate the tubes as much as possible in order to reach the unrestricted material release limits. Preheater No. 4, which was operated at the highest temperature and pressure, was selected for the experiments. Other decontamination studies such as decontamination tests on small valves with aggressive chemical, spent decontaminant treatment and decontamination tests with more recent chemical processes are also reviewed. Part of the work is being carried out as a jointly funded project with the Commission of the European Communities, as part of the Community Research Program on the Decommissioning of Nuclear Installations (1984-1988).

7485 (CONF-871018—Vol.2, pp IV.101-IV.108) **TMI-2 cleanup techniques applicable to decommissioning.** Schwartz, F.L.; Meininger, R.D. (Pentek, Inc., Coraopolis, PA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The techniques and equipment used for cleanup at Three Mile Island Unit 2 (TMI-2) that could be applied directly for decommissioning any chemical or nuclear facility are discussed. The technology discussed concentrates on those approaches that either substantially reduce exposure to the work force engaged in decommissioning or those actions that result in volume reduction of contaminated materials. The key issues presented are surface decontamination, removal of contaminated surface material, internal pipe cleaning, remote tools, and the workhorse robot.

7486 (CONF-871018—Vol.2, pp IV.109-IV.116) **Microwave decontaminator for concrete surface decontamination in JPDR.** Yasunaka, H.; Shibamoto, M.; Sukegawa, T.; Yamate, T.; Tanaka, M. (Japan Atomic Energy Research Institute, Ibaraki-ken). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Radioactive contamination of nuclear facilities must be evaluated to determine appropriate decommissioning procedures which address both worker-exposure and waste management. The Japan Atomic Energy Research Institute (JAERI) measured concrete surface contamination prior to the dismantlement of the Japan Power Demonstration Reactor (JPDR). Measured penetration-depths of the contamination were with 2cm of the surface. JAERI has developed a microwave decontaminator for concrete surface removal. It can remove the surface of concrete to a depth of more than 1cm with a single-pass, and be used for walls as well as floors. Concrete surface contamination of the JPDR will be removed by both the microwave decontaminator and conventional machines to evaluate the usefulness of the microwave decontaminator.

7487 (CONF-871018—Vol.2, pp IV.117-IV.133) **Development of a process for the removal of radioactively contaminated coatings from concrete structures, when repairing or shutting down nuclear plant.** Engelfried, R.; Klopfer, H.; Ricken, D.; Schmidt, R. (Univ. of Dortmund, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In nuclear installations, to prevent radioactive contamination of structural and plant components, their surfaces are given protective coatings. The aim of the project was the development and trial of a process for the removal of contaminated coatings. An experimental plant was built. Coatings, as used in practice, where applied to concrete, cement screed, cement-line mortar and steel plates. By application of liquid nitrogen, removal of the coatings was achieved under certain circumstances.

7488 (CONF-871018—Vol.2, pp IV.153-IV.168) **Decontamination for decommissioning of Nuclear Power Plant A-1.** Blazek, J.; Hladky, E.; Majersky, D.; Rehacek, V. (Nuclear Power Plants Research Institute, Trnava, Czechoslovakia). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Results are presented of a phase analysis of the corrosion product layers formed on a low-alloy steel of the secondary circuit and stainless steel of the explosive mixture combustion system in the NPP A-1 and results of experimental verification of decontamination efficiency of different procedures for chemical and electrochemical decontamination of these materials. A methodology is described for determination of acceptable residual contamination of metallic materials from the decommissioning of a nuclear power plant for their introduction to the environment after remelting and reprocessing.

7489 (CONF-871018—Vol.2, pp IV.169-IV.187) **Chemical decontamination of the in pile CART-TC loop for decommissioning purposes, some evaluation on the managing aspects of the aggressive solutions in radioactive areas.** Conti, M.; Mincarini, M.; Bottelli, B.; Mantega, F.; Oriani, M. (ENEA, Rome, Italy). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The experience gained and the lessons learned in testing both soft and hard chemical solutions in the decontamination of the in-pile CART-TC loop, located in ESSOR reactor at the European Communities JRC of Ispra, Italy, are described. The main objective of the work was to extend laboratory tests to a real small-scale loop in order to get operating experience on chemical decontamination of significant nuclear reactor systems and to evaluate the real advantages and limits of this technique in decommissioning activities. The main investigations were conducted in order to obtain knowledge on: testing both commercial and experimental chemical solutions, operating problems in aggressive environment, waste reduction and management, and to make an evaluation of the extension of this technique to the power plant. The results are presented.

7490 (CONF-871018—Vol.2, pp IV.188-IV.200) **Decontamination of nuclear facilities by electrochemical methods.** Pavlik, O.; Sipos, T.; Vicsevne, M.M. (Institute of Isotopes of the Hungarian Academy of Sciences, Budapest). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Three electrochemical, remotely operated decontamination equipments were developed for the Paks NPP. The first equipment was constructed for the decontamination of the main circulating pump case, the second equipment for the collectors of the steam generator and the third equipment for the main gate valve case of the primary circuit. All the equipments use movable cathodes. The main circulating pump case was decontaminated eight times. The electrolyte contained sulfuric, oxalic and phosphoric acid. The decontamination factor of the plant 10-500. The duration of the process was 8-12 hours. The collective dose for the staff (3-4 workers) was about 2-3 mSv. Only 100-200l of radioactive effluents were produced.

7491 (CONF-871018—Vol.2, pp IV.201-IV.216) **Characterization of the radioactive deposits on PWR primary circuit surfaces.** Pick, M.E. (Berkeley Nuclear Labs., England). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Results from detailed examination of the oxides on a range of Inconel 600 and stainless steel specimens from a number of PWRs are reported. A variety of techniques have been employed. These include gamma spectrometry, alpha spectrometry, scanning electron microscopy and wet chemical analysis. In addition, surface analytical techniques including secondary ion mass spectrometry (SIMS) have been used to characterize the oxides. The sources of the major radionuclides present on circuit surfaces are considered. Procedures for decontaminating PWR surfaces are described. In addition to the PWR specimens, results from a limited number of specimens from BWRs and CANDU reactors are presented.

7492 (CONF-871018—Vol.2, pp IV.243-IV.257) **Removing the WAGR co-axial ducts: an example of hands-on dismantling.** Boorman, T.; Medlock, R. (Windscale Nuclear Labs., Seascale, England). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The methods used for dismantling two of the WAGR co-axial gas ducts which connected the reactor pressure vessel to the heat exchangers are described. Each duct system is 4 1/2 metres long, 860 mm diameter and weighs 1 1/2 tons. After assessing several cutting techniques the choice of a standard oxyacetylene gas torch was made. (A market survey yielded a semi-remote profile cutter which was used on the second duct). The containment boundaries and provision of ventilation system are detailed. Radiation dose figures show that materials with surface radiation levels in the 1-10 mSv $hr^{-1}$ range can be safely removed and disposed of at modest cost and with acceptable dose uptake. In particular, the lessons are those of good planning, adequate training and a high level of team involvement. The successful completion of this work allows the planned manual removal of the reactor pressure vessel top dome to proceed with confidence.

7493 (CONF-871018—Vol.2, pp IV.285-IV.297) **Testing the demolition of concrete and pipes with explosive charges within a nuclear power plant.** Mueller, K.; Freund. (Kernforschungszentrum Karlsruhe GmbH, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

At the HDR, a former nuclear power plant, an extended nuclear safety research program began in 1974. The test facility and the appropriate accident simulations are presented. Within this program the concrete and pipe demolition by explosive charges (ZER) is one test group that began 1983. For the purposes of disassembly techniques, the HDR is a facility on which parameters known from single tests can be checked under realistic boundary conditions for their validity within a closed containment. The ZER test group was subdivided into tests on concrete demolition and pipe disassembly. These tests are discussed.

7494 (CONF-871018—Vol.2, pp IV.298-IV.310) **Explosive pipe cutting by shaped charges in an annular configuration.** Schumann, S.; Freund, H.U.; Horning, W. (Battelle-Institut e.V., Frankfurt, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

For the decommissioning of nuclear power stations it is necessary to develop dismantling techniques to minimize the dose of radioactivity for the personnel. Concerning the primary cooling system the separation of contaminated steel pipes is solved up to now only unsatisfactorily by usual cutting techniques like sawing or thermal cutting if there is impeded access to the tubing by narrow constructions. An explosive pipe cutting technique was developed to separate thick walled tubes. The simplicity of the arrangement and its easy applicability are the advantages of this dismantling method. The developed sleeve charge is assembled from linear modules surrounding the tube wall as a polygon. When initiated the projectiles formed from the metallic liner of the charge hit the tube wall simultaneously and pipes up to 610 mm diameter and 36 mm wall thickness were cut. Such pipes comply with the fresh steam pipe of a recent German boiling water reactor. The impulse load to the tube wall outside the cutting region is far below the value which would lead to destructions at the remaining pipe system. Strong confinement of the charge reduces the blastwave pressure and the damage boundary value of 1 bar is exceeded only within a distance of 3 m to the center of the tube. To avoid fragment damage it is necessary to apply a heavy protective construction. Using such a construction the developed sleeve charge technique was tested when cutting a section of the cooling system of a hot steam reactor (HDR).

7495 (CONF-871018—Vol.2, pp IV.311-IV.325) **Study on treatment of dust by dismantling.** Torikai, K.; Suzuki, K. (Science Univ. of Tokyo, Japan). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In dismantling of nuclear reactors, various kinds of treatment of dust generated by cutting or dismantling concrete structures of components of reactors are evaluated for safety, cost, and performance comparing the work in air with water. A method of dust treatment for work in air is discussed. The dry method has an easy operation in practice and a good performance in the equipment, but has problem on the prevention from radioactive contamination by diffusion of dust in air. For the purpose of advancing the strong points and eliminating the weak points in dry method, an improved venturi scrubber system is proposed for dismantling work as a dust collecting system. The system consists of dust absorbing pipe, dust collector, separator of dust and water and dust transfer equipment to a storage of waste. This system would be expected to have better performance and lower operating cost in decommissioning nuclear reactors, especially, the number of dust filters, for example, HEPA filters, will be considerably saved.

7496 (CONF-871018—Vol.2, pp IV.326-IV.338) **Diamond sawing and coring technique for biological shield concrete dismantlement.** Yanagihara, S.; Gohda, H.; Yamashita, Y.; Hasegawa, T.; Yoshida, T.; Takahashi, K. (Japan Atomic Energy Research Institute, Ibaraki-ken). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A diamond sawing and coring technique has been developed to dismantle a biological shield in the JPDR decommissioning program. Preliminary cutting tests were conducted using a prototype machine equipped with sawing and coring units to obtain the data concerning the characteristics of the cutting machine as well as to confirm the applicability of this technique for reinforced concrete. Many data including cutting rates under various cutting conditions and characteristics of by-products were obtained in the tests. Based on the results of the cutting tests, the cutting system was designed for safe and efficient dismantlement of the JPDR biological shield.

7497 (CONF-871018—Vol.2, pp IV.350-IV.360) **Decommission plans for Lovissa 1 and 2 units in Finland.** Kukkola, T. (Imatra Power Co., Helsinki, Finland). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The reactor pressure vessel will be transported in one piece to the final repository. The reactor internals will be stored inside the reactor pressure vessel, which acts as a waste container. The steam generators will be also transported to the final repository intact. The final repository will be a rock cavern at a depth of 100 meters.

7498 (CONF-871018—Vol.2, pp IV.361-IV.367) **Importance of funding in decommissioning cost estimates.** Mingst, B.C. (Mingst Engineering, Nevada City, CA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Decommissioning cost estimates have been made by several study groups for the decommissioning of pressurized-water and boiling-water nuclear power stations. The results of these studies are comparable when corrected for inflation and the differences in contingency factors applied by the study groups. The estimated dismantling costs differ far less than a factor of 2 in all cases, despite the design differences found in the plants that were studied. An analysis of the different methods available for funding the dismantling of these facilities shows the much stronger effect that the choice of funding methods has on the net cost of decommissioning. The total cost of dismantling may vary more than a factor of 4 from one funding method to another, assuming current or recent historical inflation rates. The funding methods evaluated include sinking funds, deposits, negative-salvage value depreciation, and insurance. These funding methods are taken from the NRC's Notice of Proposed Rulemaking description of acceptable funding methods. The funding analysis for this study was performed using the DECOST-86 computer code. The evaluation of funding options for a nuclear facility, and the appropriate choice of the funding method best for that facility, are found to be more important than detailed engineering studies in determining the net cost of decommissioning during the early portions of the plant's operating lifetime.

7499 (CONF-871018—Vol.2, pp IV.379-IV.393) **WAGR decommissioning: the processing of operational waste.** Boorman, T.; Medlock, R. (Windscale Nuclear Labs., Seascale, England). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In decommissioning the Windscale AGR most of the waste items have to be conditioned in some way to make them suitable for disposal. The techniques used to prepare operational waste, a term applied to all of the WAGR's removable channel items, for disposal are described. These include plug stringers (the upper part of a fuel stringer), control rods and arrestor mechanisms. A plug stringer is 10 meters in length and includes a 2 1/2 meter long neutron shield plug (NSP). The plug section is separated from the NSP and cut into convenient lengths by hands-on techniques in a ventilated facility. The NSP is cut in a shielded facility using a carborandum disc. Arrestor mechanisms are taken from the core into a modified thimble flask, crushed to a suitable length and returned. The tools and procedures adopted are described. A key feature of this work has been to use simple engineering techniques and to adapt existing facilities.

7500 (CONF-871018—Vol.2, pp V.16-V.33) **Decommissioning cost estimating and contingency application.** LaGuardia, T.S. 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The funding of nuclear power plant decommissioning has matured into an integral part of utility planning. State public utility commission regulators and the US Nuclear Regulatory Commission have recognized the need to assure the availability of funds to safely decommission these facilities at the end of their useful lives. The cost estimates for decommissioning need to reflect the changes in labor and material costs due to inflation, changes in waste disposal costs for packaging, transporting and burying radioactive materials, and the site-specific factors for each unit that account for differences in plant design and construction. Decommissioning activities involve remote tooling to segment the reactor vessel and internals, decontamination of contaminated systems to reduce occupational exposure, controlled blasting to demolish concrete structures, and removal and disposal of radioactive wastes by controlled burial. The unforeseeable problems encountered in performing these activities result in additional costs that are accounted for through contingency. The recent progress in nuclear power plant decommissioning cost estimation and contingency application are discussed. The important factor to be included in planning for the establishment of a decommissioning fund are identified, and typical results of recent estimates are provided. The nuclear industry is probably one of the first industries to plan for the eventual retirement of its facilities, and the public needs to be aware of these efforts.

7501 (CONF-871018—Vol.2, pp V.34-V.55) **Management of G2 decommissioning (UNGG Reactor).** Lourme; Richez. 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Technicatome, together with the French CEA, has developed engineering methodology for nuclear plant decommissioning management. Illustration of this methodology is provided through its applications to G2 reactor decommissioning.

7502 (CONF-871018—Vol.2, pp V.67-V.76) **Development and verification of code system for management of reactor decommissioning (COSMARD) for the JPDR decommissioning.** Onodera, S.; Yanagihara, S.; Kitanaka, T.; Tanaka, M. (Japan Atomic Energy Research Institute). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

A code system for management of reactor decommissioning (COSMARD) has been developed to estimate management data such as manpower, worker exposure, cost, related to the decommissioning of the Japan Power Demonstration Reactor (JPDR). It is also possible to make schedules of the dismantling activities by PERT calculations using the data in the code system. COSMARD was used to evaluate and plan the dismantling activities in the JPDR decommissioning program. During this study, the COSMARD proved to be a useful tool for the management of the decommissioning activities.

7503 (CONF-871018—Vol.2, pp V.79-V.88) **Computer program for estimating decommissioning costs of nuclear power plants.** Pratapagiri, G. (Atomic Energy of Canada Ltd., Montreal, Quebec). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Reliable cost estimates are essential for the planning of a decommissioning program for a nuclear facility. The preparation of such cost estimates is a complex task because there are a large number of components, equipment, and piping systems to be considered, many different levels of radioactive contamination and activation levels to be examined, corresponding waste volumes for disposal to be determined and multiple decommissioning scenarios to be evaluated. The DECOM computer program was initially developed in 1983 for use on an IBM main frame computer. In 1985, in order to provide more flexibility and ease of operation for the users of the DECOM computer program, the DECOM Code was converted so as to be usable on an IBM-PC type microcomputer. The DECOM program has been used in the past few years to do decommissioning estimates for both CANDU (Canada Deuterium Uranium) and PWR (Pressurized Water Reactor) type reactors. The estimates have been found to be within the range reported in the OECD (Organization for Economic Cooperation and Development) decommissioning cost surveys. In order to test the validity of the cost estimates prepared using DECOM, a sample of actual cost and manhour data from the Gentilly-1 Decommissioning operation have been processed through the DECOM code and it was observed that the total cost figures were accurate within a 20% range, though costs for individual activities some instances differed. The AECL DECOM computer program, based on the widely accepted unit cost factor approach, is a versatile tool for the applications in decommissioning studies.

7504 (CONF-871018—Vol.2, pp V.104-V.113) **Radiation control technology applicable to the JPDR decommissioning.** Ikezawa, Y.; Onodera, J.; Nakamura, C.; Ashikagaya, Y.; Matsui, H. (Japan Atomic Energy Research Institute, Ibaraki-ken). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

From the view of radiation control, the main features of the JPDR reactor dismantling are: 1. the work under high-level radiation and high level radioactive air contamination area is expected; the new dismantling techniques which have not been experienced in

the controlled area before will be adopted; and a great amount of materials, tools, radioactive waste and so on will be taken out from the controlled area. Considering these features, five instruments were developed to adapt for the JPDR decommissioning; i.e., remote high dose rate measuring instruments (underwater and in the air), contamination inspection monitor, respirable dust monitor, respirable dust monitor, extremely low level waste γ-scanner, and waste package contamination and dose rate monitor. These instruments are described.

7505 (CONF-871018—Vol.2, pp V.114-V.128) **Health and safety aspects of decommissioning relevant to licensing.** Weil, L.; Goertz, R. (Federal Ministry for the Environment, Bonn, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

After a brief introduction of the use of nuclear power and decommissioned nuclear installations in the Federal Republic of Germany, the safety goals that the decommissioning plan has to comply with are discussed. The safety goals have consequences concerning certain health and safety issues. Some of them which are regarded to be of special importance in the licensing procedure are addressed specifically, e.g., recycling and reuse of steel scrap, potential accidents during decommissioning, occupational exposure, and decommissioning options.

7506 (CONF-871018—Vol.2, pp VI.14-VI.28) **TMI-2 experience with remote operations technology.** Schwartz, F.L. (Pentek, Inc., Coraopolis, PA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The remote operation technology developed for use in the TMI-2 cleanup is described. Such technology and experiences are considered to have applicability for a nuclear plant decommissioning. Specifically, it addresses: mobile, remotely controlled vehicles for surveillance, sampling, light-duty, surface decontamination, and dismantling work; stationary remotely controlled surveillance equipment; and remotely controlled boring, cutting, dismantling, and manipulating tools for damaged reactor defueling and disassembly.

7507 (CONF-871018—Vol.2, pp VI.29-VI.47) **Engineering design of the Windscale Advanced Gas Cooled Reactor decommissioning system.** Ashcroft, D.J.; Collins, N.W. (United Kingdom Atomic Energy Authority, Risley, England). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The background to the WAGR decommissioning system and the stages through which it was developed before arriving at the final concepts are discussed. Included is the steel materials radioactive inventory which gives radioactivity and weight of steel materials to be size reduced and handled by the system. A detailed description of the system is given together with a typical operating sequence to provide an understanding of how the machine and its handling system work together. How the problem of radiation shine where manipulator platform service lines pass through the floor shield was overcome by careful design is discussed. Key dates of important stages in the supply of the system are included.

7508 (CONF-871018—Vol.2, pp VI.48-VI.60) **Development of cutting tools for JPDR core internals and pressure vessel dismantlement.** Ashida, S.; Nakamura, H.; Kumagai, N.; Yokota, M. (Japan Atomic Energy Research Institute, Ibaraki-ken). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The development of remote cutting tools is one of the most important reactor dismantlement topics. Since the Japan Power Demonstration Reactor (JPDR) decommissioning program started in 1981, the Japan Atomic Energy Research Institute (JAERI) has developed an underwater plasma arc cutting system for dismantling core internals and an underwater arc saw cutting system for cutting the pressure vessel of JPDR. The final check-out tests for these systems proved they have satisfactory performance for use on JPDR dismantlement.

7509 (CONF-871018—Vol.2, pp VI.61-VI.79) **Test results of concrete demolitioning by smooth blasting inside a reactor containment.** Freund, H.U.; Schumann, St.; Mueller, K.; Wegener, H. (Battelle-Institut e.V., Frankfurt, West Germany). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Explosive methods have been demonstrated to be an adequate tool for dismantling of activated or contaminated concrete. Specific advantages are realized in cases of large wall thickness and heavy steel reinforcement. Test results are reported where the blasting has been performed inside the former hot steam HDR reactor which is now in use as a nuclear reactor safety test facility. A comparison between HDR and standard type reactors with respect to main structural features is shown. The HDR facility is described in detail. The blasting experiments were aimed primarily at: optimizing the method for different types of concrete as, in particular, in Niederaichbach (KKN) and Biblis (KKB) biological shield; safety measures against dust and debris; and quantifying the dynamic loading of the blasted component, the reactor containment, and its vicinity. A great amount of effort was invested into characterizing the dynamic loading and structural response with respect to safety and predictability. For this purpose a variety of measurements were performed. The response was also been calculated using finite element models. It is shown that the blasting method can be applied in accordance with safety and regulatory requirements.

7510 (CONF-871018—Vol.2, pp VI.80-VI.94) **Abrasive-waterjet cutting of thick concrete and waterjet cleaning for nuclear facility decommissioning and decontamination.** Echert, D.C.; Hashish, M.; Marvin, M.H. (Flow Research Co., Kent, WA). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

Two tools have been developed for use by the nuclear industry: the Deep Kerf tool and the Cleaner/Scarifier tool. The Deep Kerf tool is designed to cut through thick, reinforced concrete structures to facilitate their decommissioning. It employs the abrasive-waterjet (AWJ) cutting technology. The basis of the system is a rotary nozzle that makes a slot in the concrete wide enough to accommodate the cutting tool as it advances. In this program, concrete as thick as 1.5 m was cut through from one side. A shroud and vacuum system covers the opening of the slot during cutting to contain the spoils with greater than 99% efficiency. The Cleaner/Scarifier tool was designed for removing the surface layers of contaminated concrete and decontaminating metal surfaces. It uses ultrahigh-pressure waterjets mounted on a rotating arm to remove or clean the target surface. Spoils recovery with a shroud and vacuum system is over 99% complete for both horizontal and vertical surfaces.

7511 (CONF-871018—Vol.2, pp VI.95-VI.105) **Investigations related to a one-piece removal of the reactor block in the frame of the JRR-3 reconstruction program.** Onishi, N.; Kanenari, A.; Futamura, Y.; Sakurai, H.; Suzuki, S.; Nagase, T.; Iwatani, A.; Otsubo, F. (Japan Atomic Energy Research Institute, Ibaraki-ken). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

In the Japan Atomic Energy Research Institute (JAERI), an outdated research reactor (Japan Research Reactor No.3; JRR-3) was removed to a storage facility between October 14th and November 7th, 1986. The removal of the 2250-ton reactor block (10 x 10 x 10 m) was performed as a part of a program to replace the JRR-3's core (10-MW thermal) with an upgraded research reactor core. The heavy water and fuel elements were taken out from the JRR-3 before removal work began. The reactor block was raised about 3.7 meters, using a 12-cubic meter steel frame and a center-

hole jack system. The reactor block was then transported horizontally about 34 meters on steel rails, using four 100-ton jacks, to a storage facility. Finally, the reactor block was lowered 14 meters into the storage facility. After the reactor block was stored, a new 20-MW thermal, light-water moderated and cooled JRR-3 core will be built, with criticality targeted for 1989.

7512 (CONF-871018—Vol.2, pp VI.106-VI.120) **Large scale fuel channel replacement program.** Morison, W.G.; Irvine, H.S. (Ontario Hydro, Toronto). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

The CANDU reactor was designed so that any or all of the components which make up the reactor channels can be removed and replaced. It has always been expected that at least once during the lifetime of a CANDU nuclear power station, the reactor channels would require replacement, and that this feature of being able to replace the reactor channels may allow extension of the life of a CANDU nuclear station far beyond the normal amortization life. The components of the reactor channel are shown. The process of replacing the fuel channels is discussed.

7513 (CONF-871018—Vol.2, pp VI.137-VI.146) **Steam generator replacement at Surry Power Station: techniques applicable to power station decommissioning.** McKay, H.S. (Virginia Power, Glen Allen). 1987. NTIS, PC A99/MF A01. Order Number DE87012822/JAW.

From International decommissioning symposium; Pittsburgh, PA, USA (4 Oct 1987).

During the Surry Steam Generator Repair Program it was necessary to cut the steam generator into two (2) pieces and to remove sections of the reactor coolant piping, feedwater piping, main steam piping, and instrumentation lines. Many of the cutting techniques and measures taken to minimize personnel exposure are directly applicable for use in nuclear power station decommissioning. These techniques are discussed as they were used at Surry.

7514 (GRS—60) **Simulation of pressure waves in the coolant loop of PWR type reactors with a network of one-dimensional flow channels, taking the structural flexibility into account.** Grillenberger, T. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). Nov 1985. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751271/JAW.

The DAPSY code is explained to be a universal tool for simulating and describing dynamic load effects on pipings, internals and components, and valves in the coolant loop. Excitation of pressure waves primarily is due to pipe rupture which leads to rapid pressure reduction. This is why the code very carefully calculates critical blowdown rates also for the case of only partial rupture with reduced outflow, as thus the course of disturbance is described that affects the system. A network method is presented for calculation of multidimensional geometries. As the pressure wave phenomena are observed in a low-compressibility fluid and in a system with sometimes very flexible structural components, the fluid-structure interactions are taken into account. The model presented allows to consider either quasi-static structural behaviour, or dynamic interaction of fluid and structure, depending on the configuration characteristics.

7515 (GSF—28/86) **Construction risks of nuclear power plants for use in cost-effectiveness considerations.** Bock-Werthmann, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). Aug 1986. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751275/JAW.

The construction risk study is concerned with a nuclear power station of 1300 MW(e) design output. The risk figures obtained demonstrate that construction risks of nuclear power plants form a substantial share of the total risk from all steps of the nuclear fuel cycle. When compared with other risk figures it is apparent that only the fatalities caused by the extraction of uranium are of similar magnitude. (55 references).

7516 (INIS-mf—10788) **KTA (Nuclear Engineering Committee). Annual report 1984.** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). 1985. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751294/JAW.

This annual report summarizes the activities of the KTA in the period under review, its organisational structure, administrative aspects, and budgetary data. The technical rules that have been worked out, drafted, or amended in the year 1984 are presented by reference to the various subject fields or issues, together with information on the state of completion of the rule. There are eleven new rules completed in 1984, three rules have been amended, and among the drafts worked out seven are new, and two are for amendment of existing rules. The sum of KTA publications at the end of 1984 covers 52 established rules, 11 draft versions, 42 drafts prepared, and 9 preliminary reports. (orig./HSCH).

7517 (JAERI-M—87-121) **Evaluation of leak rate by EPRI code.** Isozaki, Toshikuni; Hashiguchi, Issei; Kato, Kiyoshi; Miyazono, Shohachiro. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751444/JAW.

From 1987, a research on the leak rate from a cracked pipe under BWR or PWR operating condition is going to be carried out at the authors' laboratory. This report describes the computed results by EPRI's leak rate code which was mounted on JAERI FACOM-M380 machine. Henry's critical flow model is used in this program. For the planning of an experimental research, the leak rate from a crack under BWR or PWR operating condition is computed, varying a crack length 2c, crack opening diameter COD and pipe diameter. The COD value under which the minimum detectable leak rate of 5 gpm is given is 0.22 mm or 0.21 mm under the BWR or PWR condition with 2c = 100 mm and 16B pipe geometry. The entire lists are shown in the appendix.

7518 (Juel-Spez—335) **Safety related studies on the accident behaviour of the HTR-modul. Supplementary volume with detailed individual contributions on the Juel-Spez--260 report.** Mertens, J. (comp.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Nov 1985. 212p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88751296/JAW.

9 individual papers deal with the following subjects: Plant description, analyses of systems and courses of events, system reliability, primary coolant circuit thermodynamics and component load, processes in the event of a steam generator leakage, fission product release from the HTR-modul reactor core, fission product release from the plant due to an incident, reactivity behaviour of fuel spheres in the discharge room of the HTR-modul, consequences of an accident and related risks; description of a complete risk scenario.

7519 (Juel-Spez—405) **Methodical treatment of dependent failures in risk analyses. Contribution to the status report on phase B of the German Risk Study.** Hennings, W.; Mertens, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Nukleare Sicherheitsforschung). Jun 1987. 113p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751297/JAW.

Reprint of the internal report KFA-ISF-IB--2/85 from January 1985.

In this report the state-of-the-art regarding dependent failures is compiled and commented on. Among others the following recommendations are infered: The term 'common mode failures' should be restricted to failures of redundant, similar components; the generic term is 'dependent failures' with the subsets 'causal failures' and 'common cause failures'. In risk studies, dependent failures should be covered as far as possible by 'explicit methods'. Nevertheless an uncovered rest remains, which should be accounted for by sensitivity analyses using 'implicit methods'. For this the homogeneous Marshall-Olkin model is recommended. Because the available reports on operating experiences only record 'common mode

failures' systematically, it is recommended to additionally apply other methods, e.g. carry out a 'precursor study'.

7520 **(KTA-GS—47) KTA (Nuclear Engineering Committee) status report, concept concerning a system for classification of events and incidents in nuclear power stations, for design improvement, June 1985.** (Kerntechnischer Ausschuss (KTA), Koeln (Germany, F.R.)). 1985. 66p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751299/JAW.

The concept presented is intended to provide for an optimization of precautionary, engineered safety measures. For this purpose, analyses and evaluations of the design of nuclear power plants are made and results are collected and represented in a systematic scheme that defines concrete steps and means by which the given protective effects are to be achieved. This systematic concept relies on data obtained by deterministic methods, describing initiating events and incident scenarios. The classification of incident scenarios into five different categories is made according to frequency of occurrence. To these categories, fundamental and specially derived protective action or means and methods are assigned, which subsequently are defined and interpreted in terms of system- or component-related limit values.

7521 **(NUREG/CR—4692) Operating experience review of failures of power operated relief valves and block valves in nuclear power plants.** Murphy, G.A.; Cletcher, J.W. II. (Oak Ridge National Lab., TN (USA). Nuclear Operations Analysis Center). Oct 1987. Contract AC05-84OR21400. 75p. (ORNL/NOAC—233). NTIS, PC A04/MF A01 - GPO. Order Number TI88000626/JAW.

This report contains a review of nuclear power plant operating events involving failures of power-operated relief valves (PORVs) and associated block valves (BVs). Of the 230 events identified, 101 involved PORV mechanical failure, 91 were attributable to PORV control failure, 6 events involved design or fabrication of the PORVs, and 32 events involved BV failures. The report contains a compilation of the PORV and BV failure events, including failure cause and severity. The events are identified as to plant and valve manufacturer. An assessment of the need to upgrade PORVs and BVs to safety-grade status concludes that such action would improve PORV and BV reliability. The greatest improvement in reliability would result from using newer, more reliable PORV designs and improving testing, diagnostics, and maintenance applied to PORVs and BVs, particularly the BV motor operator. A summary of interviews conducted with four PORV manufacturers is also included in the report.

7522 **Self-actuated nuclear reactor shutdown system using induction pump to facilitate sensing of core coolant temperature.** Sievers, R.K.; Cooper, M.H.; Tupper, R.B. (to Dept. of Energy, Washington, DC). US Patent 4,698,200. 6 Oct 1987. Filed date 23 Dec 1985. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a nuclear reactor including at least one fuel assembly having an upper end from which exits coolant after flowing upwardly through and being heated within the fuel assembly and at least one reactivity control assembly disposed adjacent the fuel assembly and having a bottom nozzle with an inlet, this patent describes a top nozzle with an outlet, radially spaced outer and inner elongated ducts extending between and mounted at respective upper and lower ends to the nozzles. At least one neutron absorber bundle is disposed in the inner duct for movement between raised and lowered positions axially along the inner duct and a driveline for moving the absorber bundle. The ducts define an annular space extending between the nozzles. The top nozzle outlet is disposed adjacent the upper end of the fuel assembly. A self-actuated shutdown system is incorporated in the reactivity control assembly which comprises: (a) a tubular member; (b) a latching mechanism; (c) orifice means defining at least one flow opening through the inner duct above the absorber bundle so as to establish flow communication between the inner duct and the annular space between the inner and outer ducts; and (d) pumping means disposed adjacent the bottom nozzle and in flow communication with the inlet. The pumping means establish flow communication between the absorber bundle and the annular space at the inner duct lower end such that the upward driving flow of primary coolant, in turn, creates a suction head within the outer flow channel of the top nozzle.

7523 **Impacts of hazardous technology: The psychosocial effects of restarting TMI-1.** Sorensen, J.; Soderstrom, J.; Copenhaver, E.; Carnes, S.; Bolin, R. New York, NY; State University of New York Press (1987). 233p. State University of New York Press, State University Plaza, New York, NY 12246.

This book presents an evaluation of the psycho-social impacts of hazardous technology. Using a multiple research strategy, the authors show the possible effects of restarting the undamaged reactor at Three Mile Island. The book includes background information concerning environmental policy, the accident and restart issues, and forecasted impacts and implications for environmental management. The topic, however, extends well beyond that of TMI and nuclear power. Linkages are made with other environmental problems including chemical accidents such as Bhopal and waste disposal problems such as Love Canal.

## 25 ENERGY STORAGE

7524 **(N—87-29914) Space electrochemical research and technology (SERT).** (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1987. 364p. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—). NTIS, PC A16/MF A01.

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

The conference provided a forum to assess critical needs and technologies for the NASA electrochemical energy conversion and storage program. It was aimed at providing guidance to NASA on the appropriate direction and emphasis of that program. A series of related overviews were presented in the areas of NASA advanced mission models (space stations, low and geosynchronous Earth orbit missions, planetary missions, and space transportation). Papers were presented and workshops conducted in a variety of technical areas, including advanced rechargeables, advanced concepts, critical physical electrochemical issues, and modeling.

7525 **(N—87-29914, pp vp) JPL future missions and energy storage technology implications.** Pawlik, E.V. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

The mission model for JPL future programs is presented. This model identifies mission areas where JPL is expected to have a major role and/or participate in a significant manner. These missions are focused on space science and applications missions, but they also include some participation in space station activities. The mission model is described in detail followed by a discussion on the needs for energy storage technology required to support these future activities.

7526 **(N—87-29914, pp vp) View from the AIAA: introduction of new energy storage technology into orbital programs.** Badcock, C. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

The development of new energy storage technology must be heavily weighted toward the application. The requirements for transitioning low risk technology into operational space vehicles must remain the central theme even at the preliminary development stages by the development of efforts to define operational issues and verify the reliability of the system. Failure to follow a complete plan that results in a flight qualified unit may lead to an orphan technology. Development efforts must be directed toward a stable development where changes in design are evolutionary and end items are equivalent to flight units so that life and qualification testing can be used as a vehicle to demonstrate the acceptability of the technology.

7527 (N—87-29914, pp vp) **Air Force electrochemical power research and technology program for space applications.** Allen, D. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

An overview is presented of the existing Air Force electrochemical power, battery, and fuel cell programs for space application. Present thrusts are described along with anticipated technology availability dates. Critical problems to be solved before system applications occur are highlighted. Areas of needed performance improvement of batteries and fuel cells presently used are outlined including target dates for key demonstrations of advanced technology. Anticipated performance and current schedules for present technology programs are reviewed. Programs that support conventional military satellite power systems and special high power applications are reviewed. Battery types include bipolar lead-acid, nickel-cadmium, silver-zinc, nickel-hydrogen, sodium-sulfur, and some candidate advanced couples. Fuel cells for pulsed and transportation power applications are discussed as are some candidate advanced regenerative concepts.

## 2505 Flywheels

7528 (N—87-29914, pp vp) **Satellite power using magnetically suspended flywheel stack.** Kirk, J.A.; Anand, D.K. (Technical Planning, Inc., Beltsville, MD). Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Research activities with magnetically suspended flywheels are reported. The purpose of the effort is to critically examine and further the development of all the key technologies which impact the inertial energy storage system. The results presented discuss the concept of a magnetically suspended flywheel as it applies to a 500 Watt-hour energy storage system. The proposed system is currently under hardware development and is based upon two pancake magnetic bearings arranged in a vertical stack.

7529 (N—87-29914, pp vp) **Application of advanced flywheel technology for energy storage on space station.** Olszewski, M. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

In space power applications where solar inputs are the primary thermal source, energy storage is necessary to provide a continuous power supply during the eclipse portion of the orbit. Because of their potentially high storage density, flywheels are being considered for use as the storage system on the proposed orbiting space station. During the past several years, graphite fiber technology has advanced, leading to significant gains in flywheel storage density. Use of these improved fibers in experimental flywheel rims has resulted in ultimate storage densities of 878 kJ/kg. With these high strength graphite fibers, operational storage densities for flywheel storage modules applicable to the space station power storage could reach 200 kJ/kg. This module would also be volumetrically efficient occupying only about 1 cu m. Because the size and mass of the flywheel storage module are controlled by the storage density, improvements in fiber strength can have a significant impact on these values. With the improvements anticipated within the next five years, operational storage density on the order of 325 kJ/kg may be possible for the flywheel module.

## 2506 Thermal

*REFER ALSO TO CITATION(S) 7407*

7530 (EUR—10928) **Evaluation of thermal storage for solar heating systems: Executive summary, Final report.** Marshall, R. (University Coll., Cardiff (UK)). 1987. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900219/JAW.

The purpose of this study is to develop mathematical relationships between solar thermal storage system parameters. Items studied are pipe losses, pump power, storage material heat transfer capacity, and thermal stratification. The result of this study is the ability to predict a system's performance. 15 refs., 13 figs., 5 tabs.

7531 (FRNC-TH—3121) **Study of solid-gas chemical heat pumps for low temperature heat storage.** Bourdeau, M. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). 20 Jun 1985. 219p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750580/JAW.

This study is limited to the chemical heat pumps, especially those with reversible chemical reaction (absorption/desorption) between solid and gaseous phases. General properties and characteristics of these pumps are given and the main applications are discussed: thermal energy transport with containers from the production site (nuclear plants rejections) to the consumption site, short-term storage of solar energy and optimization of the coefficient of performance, and seasonal storage of solar energy (space heating and hot water production). A theoretical study of the heat and mass transfers in a porous bed type reaction medium is presented.

## 2509 Batteries

7532 (N—87-29914, pp vp) **KOH concentration effect on cycle life of nickel-hydrogen cells.** Lim, H.S.; Verzwyvelt, S.A. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

A cycle life test of Ni/$H_2$ cells containing electrolytes of various KOH concentrations and a sintered type nickel electrode was carried out at 23 C using a 45 min accelerated low Earth orbit (LEO) cycle regime at 80 percent depth of discharge. One of three cells containing 26 percent KOH has achieved over 28,000 cycles, and the other two 19,000 cycles, without a sign of failure. Two other cells containing 31 percent KOH electrolyte, which is the concentration presently used in aerospace cells, failed after 2979 and 3620 cycles. This result indicates that the cycle life of the present type of Ni/$H_2$ cells may be extended by a factor of 5 to 10 simply by lowering the KOH concentration. Long cycle life of a Ni/$H_2$ battery at high depth-of-discharge operation is desired, particularly for an LEO spacecraft application. Typically, battery life of about 30,000 cycles is required for a five year mission in an LEO. Such a cycle life with presently available cells can be assured only at a very low depth-of-discharge operation. Results of testing already show that the cycle life of an Ni/$H_2$ cell is tremendously improved by simply using an electrolyte of low KOH concentration.

7533 (N—87-29914, pp vp) **Long-term storage of nickel-hydrogen cells.** Vaidyanathan, H. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Representative samples of nickel hydrogen cells for the INTELSAT program were used to evaluate the effects of prolonged storage under passive conditions such as open circuit discharged at 0 C, room temperature, and -20 C, and under quasidynamic conditions such as top-off charge and trickle charge. Cell capacity declines when cells are stored open-circuit discharged at room temperature, and a second plateau occurs in the discharge curve. Capacity loss was 47 percent for a cell with hydrogen precharge and 24.5 percent for one with no hydrogen precharge. Capacity recovery was observed following top-off charge storage of cells which had exhibited faded capacity as a result of passive storage at room temperature. Cells stored either at -20 C or on trickle charge maintained their capacity. At 0 C storage, the capacity of all three cells under tests was greater than 55 Ah (which exceeds the required minimum of 44 Ah) after 7 months.

7534 (N—87-29914, pp vp) **Cost reductions in nickel-hydrogen battery.** Beauchamp, R.L.; Sindorf, J.F. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Significant progress was made toward the development of a commercially marketable hydrogen nickel oxide battery. The costs projected for this battery are remarkably low when one considers where the learning curve is for commercialization of this system. Further developmental efforts on this project are warranted as the $H_2$/NiO battery is already cost competitive with other battery systems.

7535 (N—87-29914, pp vp) **Advanced nickel-cadmium batteries for geosynchronous spacecraft.** Pickett, D.F.; Lim, H.S.; Krause, S.J.; Verzwyvelt, S.A. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

A nickel cadmium battery was developed that can be operated at 80 percent depth of discharge in excess of 10 years in a geosynchronous orbit application, and has about a 30 percent weight savings per spacecraft over present nickel cadmium batteries when used with a 1000 watts eclipse load. The approach used in the development was to replace nylon separators with inert polymer impregnated zirconia, use electrochemically deposited plates in place of conventional chemically precipitated ones, and use an additive to extend negative plate lifetime. The design has undergone extensive testing using both engineering and protoflight cell configurations.

7536 (N—87-29914, pp vp) **Aluminum-oxygen batteries for space applications.** Niksa, M.J.; Wheeler, D.J. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

An aluminum oxygen fuel cell is under development. Several highly efficient cell designs were constructed and tested. Air cathodes catalyzed with cobalt tetramethoxy porphorin have demonstrated more than 2000 cycles in intermittant use conditions. Aluminum alloys have operated at 4.2 kWH/kg at 200 mA/sq cm. A novel separator device, an impeller fluidizer was coupled with the battery to remove the solid hydrargillite discharge product. A 60 kW, 720 kWH battery system is projected to weigh about 2200 lbs., for an energy density of 327 WH lb.

7537 (N—87-29914, pp vp) **Development of ambient temperature secondary lithium cells.** Subbarao, S.; Shen, D.H.; Dawson, S.; Deligiannis, F.; Taraszkiewicz, J.; Halpert, G. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

JPL is developing ambient temperature secondary lithium cells for future spacecraft applications. Prior studies on experimental laboratory type Li-$TiS_2$ cells yielded promising results in terms of cycle life and rate capability. To further assess the performance of this cell, 5 Ah engineering model cells were developed. Initially baseline cells were designed and fabricated. Each cell had 15 cathodes and 16 anodes and the ratio of anode to cathode capacity is 6:1. A solution of 1.5 molar $LiAsF_6$ in 2Me-THF was used as the electrolyte. Cells were evaluated for their cycle life at C/1 and C/5 discharge rates and 100 percent depth of discharge. The cells were cycled between voltage limits 1.7 and 2.8 volts. The rate of charge in all cases is C/10. The results obtained indicate that cells can operate at C/10 to C/2 discharge rates and have an initial energy density of 70 Wh/kg. Cells delivered more than 100 cycles at C/2 discharge rate. The details of cell design, the test program, and the results obtained are described.

7538 (N—87-29914, pp vp) **Development of lithium-thionyl chloride batteries for Centaur.** Halpert, G.; Frank, H.; Lutwack, R. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Lithium thionyl chloride ($LiSOCl_2$) primary cells and batteries have received considerable attention over the last several years because of their high theoretical specific energy and energy density. The objective was to develop a 300 wh/kg cell capable of safe operation at C/2 rate and active storage life for 5 to 10 years. This technology would replace other primary cell technologies in NASA applications mainly the silver zinc (AgZn) batteries presently in use. The $LiSOCl_2$ system exceeds the capabilities of the AgZn in terms of specific energy of 300 wh/kg (compared with 100 wh/kg for AgZn), active storage life of 10 to 20 times the 3 to 6 months active storage and has a significantly lower projected cost.

7539 (N—87-29914, pp vp) **Na/beta-alumina/NaAlCl4, $Cl_2$/C circulating cell.** Cherng, J.Y.; Bennion, D.N. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

A study was made of a high specific energy battery based on a sodium negative electrode and a chlorine positive electrode with molten $AlCl_3$-NaCl electrolyte and a solid beta alumina separator. The basic performance of a Na beta-alumina $NaAlCl_4$, $Cl_2$/C circulating cell at 200 C was demonstrated. This cell can be started at 150 C. The use of melting sodium chloroaluminate electrolyte overcomes some of the material problems associated with the high working temperatures of present molten salt systems, such as Na/S and LiAl/FeS, and retains the advantages of high energy density and relatively efficient electrode processes. Preliminary investigations were conducted on a sodium-chlorine static cell, material compability, electrode design, wetting, and theoretical calculations to assure a better chance of success before assembling a Na/$Cl_2$ circulating cell. Mathematical models provide a theoretical explanation for the performance of the $NaCl_2$ battery. The results of mathematical models match the experimental results very well. According to the result of the mathematical modeling, an output at 180 mA/sq cm and 3.2 V can be obtained with optimized cell design.

7540 (N—87-29914, pp vp) **Development of new sealed bipolar lead-acid battery.** Attia, A.I.; Rowlette, J.J. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

New light weight composite bipolar plates which can withstand the corrosive environment of the lead acid battery have made possible the construction of a sealed bipolar lead acid battery that promises to achieve very high specific power levels and substantially higher energy densities than conventional lead acid batteries. Performance projections based on preliminary experimental results show that the peak specific power of the battery can be as high as 90 kW/kg, and that a specific power of 5 kW/kg can be sustained over several thousand pulses.

7541 (N—87-29914, pp vp) **EXAFS: new tool for study of battery and fuel cell materials.** Mcbreen, J.; Ogrady, W.E.; Pandya, K.I. (Case Western Reserve Univ., Cleveland, OH). Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Extended x-ray absorption fine structure (EXAFS) is a powerful technique for probing the local atomic structure of battery and fuel cell materials. The major advantages of EXAFS are that both the probe and the signal are x-rays and the technique is element selective and applicable to all states of matter. This permits in situ studies of electrodes and determination of the structure of single components in composite electrodes, or even complete cells. EXAFS specifically probes short range order and yields coordination numbers, bond distances, and chemical identity of nearest neighbors. Thus, it is ideal for structural studies of ions in solution and the poorly crystallized materials that are often the active materials or catalysts in batteries and fuel cells. Studies on typical battery and fuel cell components are used to describe the technique and the capability of EXAFS as a structural tool in these applica-

tions. Typical experimental and data analysis procedures are outlined. The advantages and limitations of the technique are also briefly discussed.

7542 (N—87-29914, pp vp) **Polyphase alloys as rechargeable electrodes in advanced battery systems.** Huggins, R.A. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

The rechargeability of electrochemical cells is often limited by negative electrode problems. These may include loss of capacity, increased impedance, macroscopic shape change, dendrite growth, or a tendency for filamentary or whisker growth. In principle, these problems can be reduced or eliminated by the use of alloys that undergo either displacement or insertion reactions at reactant species activities less than unity, rather than pure elements. The fundamental reasons for some of these problems with elemental electrodes, as well as the basic principles involved in the different behavior of alloys, are briefly discussed. More information is now available concerning the thermodynamic and kinetic properties of a number of alloys of potential interest for use as electrodes in elevated temperature lithium battery systems. Recent results have extended these results down to ambient temperatures, indicating that some such materials may be of interest for use with new low temperature molten salt electrolytes, or with organic solvent electrolytes. The all solid mixed conductor matrix concept is also reviewed.

7543 (N—87-29914, pp vp) **Structural models for nickel electrode active mass.** Cornilsen, B.C.; Karjala, P.J.; Loyselle, P.L. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Raman spectroscopic data allow one to distinguish nickel electrode active mass, alpha and beta phase materials. Discharges active mass is not isostructural with beta-$Ni(OH)_2$. This is contrary to the generally accepted model for the discharged beta phase of active mass. It is concluded that charged active mass displays a disordered and nonstoichiometric, nonclose packed structure of the R3 bar m, NiOOH structure type. Raman spectral data and x ray diffraction data are analyzed and shown to be consistent with this structural model.

7544 (N—87-29914, pp vp) **Regenerative fuel cells for space applications.** Appleby, A.J. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

After several years of development of the regenerative fuel cell (RFC) as the electrochemical storage system to be carried by the future space station, the official stance has now been adopted that nickel hydrogen batteries would be a better system choice. RFCs are compared with nickel hydrogen and other battery systems for space platform applications.

7545 (N—87-29914, pp vp) **AC impedance study of degradation of porous nickel battery electrodes.** Lenhart, S.J.; Macdonald, D.D.; Pound, B.G. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

AC impedance spectra of porous nickel battery electrodes were recorded periodically during charge/discharge cycling in concentrated KOH solution at various temperatures. A transmission line model (TLM) was adopted to represent the impedance of the porous electrodes, and various model parameters were adjusted in a curve fitting routine to reproduce the experimental impedances. Degradation processes were deduced from changes in model parameters with electrode cycling time. In developing the TLM, impedance spectra of planar (nonporous) electrodes were used to represent the pore wall and backing plate interfacial impedances. These data were measured over a range of potentials and temperatures, and an equivalent circuit model was adopted to represent the planar electrode data. Cyclic voltammetry was used to study the characteristics of the oxygen evolution reaction on planar nickel electrodes during charging, since oxygen evolution can affect battery electrode charging efficiency and ultimately electrode cycle life if the overpotential for oxygen evolution is sufficiently low.

7546 (N—87-29914, pp vp) **Effect of structure on current and potential distributions in porous electrode.** Lanzi, O.; Landau, U. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Porous electrodes generally contain constricted macropores and localized micropores. The effects of the macropore constrictions on the resistance of a capillary were studied and an analytical model was developed for predicting the current distribution in a constricted macropore which directly includes constriction effects and does not require an empirical tortuosity parameter. The current and concentration distributions in localized micropores were also investigated and it was shown that the microporous area is fully accessible to charge and mass transfer processes. From these analyses it was concluded that the micropores primarily affect the kinetics of the interfacial processes by contributing to the interfacial area, while the macropores impose ohmic and mass transport limitations through the volume of the porous electrode.

7547 **Multicomponent phase diagrams for battery applications. I. Phase diagram and trajectory calculations.** Aselage, T.L.; Hellstrom, E.E. (Sandia National Labs., Albuquerque, NM 87185). *Journal of the Electrochemical Society;* 134: No. 8A, 1929-1931(Aug 1987). Contract AC04-76DP00789.

This article describes a simple method for calculating isothermal, isobaric phase diagrams for m-component systems in which the phases present can be considered as stoichiometric compounds. Throughout, it emphasizes battery applications for which it presents equations to determine the following: the equilibrium m-phase region to which a given overall composition belongs, the composition at which adding a single component moves the system from one equilibrium m-phase region into another, and the voltage of each equilibrium m-phase region in a particular electrochemical cell. Additionally, it describes the concept of trajectories in a phase diagram, which is useful in understanding charge and discharge paths in a battery with an m-component electrode, and chemical pretreatment of electrodes in batteries.

7548 **Multicomponent phase diagrams for battery applications. II. Oxygen impurities in the Li(Si)/FeS/sub 2/ battery cathode.** Aselage, T.L.; Hellstrom, E.E. (Sandia National Labs., Albuquerque, NM 87185). *Journal of the Electrochemical Society;* 134: No. 8A, 1932-1937(Aug 1987). Contract AC04-76DP00789.

The effect on the voltage response of the Li(Si)/FeS/sub 2/ thermal battery due to Fe/sub 2/O/sub 3/, FeSO/sub 4/, and Fe/sub 2/(SO/sub 4/)/sub 3/ impurities in the FeS/sub 2/ cathode has been studied. Calculations were made of the pertinent equilibrium phase relations in the Li-Fe-S-O system at 400°C, and of the voltage of each of the four-phase regions vs. a Li(Si) anode (44 weight percent Li). The calculations showed that these impurities in the FeS/sub 2/ cathode can all cause voltages that are higher than the steady-state voltage of the battery. The study showed that equilibrating FeS/sub 2/ cathode material that contains oxygen impurities with a small amount of a compound containing Li shifts the overall cathode composition into one of three four-phase regions that exhibits the steady-state battery voltage.

# 29 ENERGY PLANNING AND POLICY

*REFER ALSO TO CITATION(S) 7584*

## 2901 Energy Analysis And Modeling

**7549 (EUR—9694) The model EURECA: Statement of the question and simulations: Final report.** Postiaux, J.M. (Universite Libre de Bruxelles (Belgium)). 1985. 37p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900123/JAW.

This report describes the present situation of the macroeconomic energy model EURECA. It describes further case studies realized by means of this model with the aim of answering questions in the fields of economy and energy. The first part puts into evidence the principal mechanisms of the model and indicates which multipliers were obtained for energy after aggregation of the national results. The energetic character of EURECA is particularly emphasized. The second part is centered on the presentation of the elasticities of the aggregates in respect to the important economic variables, i.e., public spending, exchange rates, world energy demand and the price of imported energy.

**7550 (IFP—35-066-A) Modelization of the relationship between economical growth, energy and debts in the developing countries: application to Indonesia-Statistical annex.** Fevrier, S. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). 25 Apr 1986. 120p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750582/JAW.

Statistical data and graphics about Indonesia energy consumption/production, financial debt of the country, economical growth evolution are presented as a function of the sector (industry, house hold, etc...), of the energy source (coal, oil, electricity) and various other parameters (export, import, ...). Data are given from 1965 to 1983.

## 2902 Economics And Sociology

*REFER ALSO TO CITATION(S) 7432, 7435, 7523, 7585, 8341*

## 2903 Environment, Health, And Safety

*REFER ALSO TO CITATION(S) 7202, 7302, 7576, 7826, 7850, 7851, 7852, 7859, 7860, 7861, 7888, 7889, 7890, 7891, 7892, 7893, 7912, 8341*

**7551 (PB—87-232245/XAB) Comments on EPA's (Environmental Protection Agency's) effluent-limitation guidelines for the nonferrous-metals manufacturing industries. Final report.** (JACA Corp., Fort Washington, PA (USA)). Jan 1984. 87p. NTIS, PC A05/MF A01.

The report presents the JACA Corporation's comments regarding effluent-limitation guidelines, and the technical and economic support documents associated with the guidelines for four metals: secondary aluminum, secondary copper, secondary silver, and secondary lead. Where possible, recommendations are made that should be incorporated in the regulations. These comments were formulated on the basis of extensive reviews of the support documents, other docket records, public comments, discussions with the Office of Advocacy of the U.S. Small Business Administration (SBA), discussions with EPA personnel and trade association personnel, consultants, and JACA's own experience in regulatory analysis.

**7552 (PB—88-102447/XAB) Site program - Superfund Innovative Technology Evaluation - new approaches to cleaning up hazardous-waste sites.** Hill, R.D. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Sep 1987. 14p. (EPA—600/D-87/238). NTIS, PC A03/MF A01.

See also PB—87-181939.

The U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD), joining with the Office of Solid Waste and Emergency Response (OSWER), has initiated the Superfund Innovative Technology Evaluation (SITE) program. The SITE program will help EPA find, test, and encourage the use of new ways to destroy, stabilize, or otherwise treat hazardous wastes, rather than just burying them in the ground. The overall goal of the SITE program is to maximize the use of alternatives to land disposal and containment at Superfund sites. To accomplish this goal, the program will provide reliable cost and performance information on technologies that offer an alternative to land disposal. This information will be generated by conducting pilot-scale or full-scale demonstrations of alternative technologies at Superfund sites. The SITE program is discussed and the first 11 systems to be demonstrated are described.

**7553 (PB—88-103023/XAB) SITE (Superfund Innovative Technology Evaluation) program: the results to date.** Hill, R.D. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Sep 1987. 12p. (EPA—600/D-87/260). NTIS, PC A03/MF A01.

The Environmental Protection Agency's Office of Research and Development (ORD), joining with the Office of Solid Waste and Emergency Response (OSWER), has initiated the Superfund Innovative Technology Evaluation (SITE) program. The SITE program will help EPA find, test, and encourage the use of new ways to destroy, stabilize, or otherwise treat hazardous wastes, rather than just bury them in the ground. The overall goal of the SITE program is to maximize the use of alternatives to land disposal and containment at Superfund sites. To accomplish this goal, the program will provide reliable cost and performance information on technologies that offer an alternative to land disposal. This information will be generated by conducting pilot-scale or full-scale demonstrations of alternative technologies at Superfund sites.

**7554 (PB—88-103056/XAB) Hazardous-waste detoxification - science and technology.** Dial, C.J.; Glaser, J.A. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Sep 1987. 19p. (EPA—600/D-87/291). NTIS, PC A03/MF A01.

Current hazardous-waste-management practices in the United States are discussed. Changes in the management practices required by recent legislative amendments to both the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act are explained. Both established and emerging technologies are discussed. Limitations of these technologies and the opportunities for technology development are reviewed.

**7555 (PB—88-103759/XAB) National Institute for Occupational Safety and Health projects for Fiscal Year 1987.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 211p. (DHHS/PUB/NIOSH—87-106). NTIS, PC A10/MF A01.

See also PB—85-119170.

The National Institute for Occupational Safety and Health (NIOSH) is the Federal lead agency in health for preventing occupational diseases and injuries. Because NIOSH is a scientific institute, not a regulatory agency, its influence on the prevention of occupational-health problems depends, to a large extent, upon the scientific quality of its findings and recommendations. In short, NIOSH fulfills its leadership mission through suasion based on scientific integrity. NIOSH Projects for Fiscal Year 1987 are faithful to the prevention of the top ten leading work-related diseases and injuries.

**7556 (PB—88-109699/XAB) Directory of commercial hazardous-waste-management facilities. Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Aug 1987. 265p. (EPA—530/SW-87/024). NTIS, PC A12/MF A01.

See also PB—86-178431.

The document provides a listing of commercial hazardous waste management facilities, along with information on the types of commercial services offered (e.g., treatment, storage, disposal, or recycling), and the types of wastes managed. The list does not constitute a list of approved facilities. It is a compilation of data that is

currently available from EPA data bases. The data presented herein is to the knowledge of the EPA representative of the commercial services available at these facilities at the time of data collection.

## 2905 Research, Development, Demonstration, And Commercialization

*REFER ALSO TO CITATION(S) 7138, 7427, 7428, 7429, 7430, 7433*

7557 **(DOE/ER—0352) Summaries of FY 1987 engineering research.** (USDOE Office of Energy Research, Washington, DC. Engineering and Geosciences Div.). Nov 1987. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002572/JAW.

This report documents the Basic Energy Sciences (BES) Engineering Research program for fiscal year 1987; it provides a summary for each of the program projects in addition to a brief program overview. The report is intended to provide staff of Congressional committees, other executive departments, and other DOE offices with substantive program information so as to facilitate governmental overview and coordination of Federal research programs. Of equal importance, its availability facilitates communication of program information to interested research engineers and scientists.

7558 (EPRI-CS—5186, pp 31.1-31.19) **AFBC technology transfer plan.** Tavoulareas, S. Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

This is a collection of diagrams and briefs on the objectives of the Electric Power Research Institute (EPRI) for atmospheric fluidized bed combustion (AFBC). These include utilizing the AFBC demonstration plants and other operating facilities to collect technical and economic data and delivering to the utilities the right tools and information for generation expansion planning, design evaluation/optimization and plant operation. These briefs include what data the EPRI will collect and disseminate through the utility sector and include cost accounting, revenue requirements, fuel and sorbent performance, boiler efficiency, etc. Software packages are also available and briefly discussed.

## 2906 Nuclear Energy

*REFER ALSO TO CITATION(S) 7451, 7523, 8268*

## 2910 Conservation

*REFER ALSO TO CITATION(S) 7585, 7586*

## 2920 Supply, Demand, And Forecasting

*REFER ALSO TO CITATION(S) 7225, 7226, 7425, 7550*

## 2930 Policy, Legislation, And Regulation

7559 (EPRI-CS—5186, pp 37.1-37.12) **Licensing requirements for AFBC boilers.** Houston, R.J.; Niece, J.E. (GAI Consultants, Inc., Monroeville, PA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The following paper discusses the licensing requirements for AFBC boilers as well as the siting considerations necessary for project approval. An initial investigation of permit and other approval requirements is recommended prior to final site selection; the specific requirements are then determined through meetings with federal and state agencies. The permits typically required for an AFBC boiler include prevention of significant deterioration; national pollutant discharge elimination system; solid waste disposal;fly ash disposal; and building and fire safety. Depending upon the site, the regulations of the state, and whether mining of coal and/or limestone will take place, the following permits and approvals could also be required; environmental impact statement (EIS) or environmental assessment; section 404 and section 10; mining; resource conservation and recovery act; and zoning. The federal, state, and local permit requirements are discussed in detail in the report.

## 2940 Fossil Fuels

*REFER ALSO TO CITATION(S) 7138, 7223, 7225, 7226, 7227, 7228*

## 2960 Electric Power

7560 **(AD-A—184083/4/XAB) Survey state of the art: electrical-load management techniques and equipment. Final report, 2 May-23 October 1986.** Khosla, N. (Enviro-Management and Research, Inc., Springfield, VA (USA)). 31 Oct 1986. 230p. NTIS, PC A11/MF A01.

Tactical military systems rely extensively on electric power in the field. Generating-capacity requirements can be minimized by relying on state-of-the-art load-management techniques. The report provides an overview of the techniques used, and indicates that smaller energy-management systems (EMS), in particular, may be applicable to tactical military systems. The report identifies load-management techniques and equipment whose application will: (1) reduce the extent of generation equipment needed by tactical systems; (2) improve equipment utilization, reducing fuel consumption and operating cost, (3) improve system reliability/availability, and (4) permit better management of equipment operation and resources in meeting mission goals. Appendix A contains a detailed discussion of remote control systems used for load management, Appendix B contains a listing of selected EMS manufacturers, and Appendix C contains desriptive literature on selected energy management systems.

7561 **(DOE/EIA—0226(87/08)) Electric power monthly, August 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 16 Nov 1987. 47p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. Order Number DE88002779/JAW.

The data in this report are presented for a wide audience including Congress, Federal and State agencies, the electric utility industry, and the general public. The Energy Information Administration (EIA) collected the information in this report to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (Public Law 93-275) as amended. Total net generation by electric utilities in the US reached a record high in August 1987 - 247,638 gigawatthours. The previous 1-month net generation record occurred in July 1987 when electric utilities generated 247,461 gigawatthours of electricity. The record-setting level of net generation from nuclear (41,352 gigawatthours, reached in August 1987) was 3.4% higher than in January 1987, the previous monthly high. Net generation from coal reached 143,190 gigawatthours in August 1987. This was the second-highest level of coal-fired net generation, surpassed only by the July 1987 level of 143,503 gigawatthours.

### 2980 Consumption And Utilization

*REFER ALSO TO CITATION(S) 7734*

### 2990 Unconventional Sources And Power Generation

*REFER ALSO TO CITATION(S) 7576*

## 30 DIRECT ENERGY CONVERSION

*REFER ALSO TO CITATION(S) 7524, 7527, 7678*

### 3003 Thermoelectric Generators

*REFER ALSO TO CITATION(S) 7303*

### 3005 Fuel Cells

*REFER ALSO TO CITATION(S) 7541, 7544*

7562 (AD-A—184605/4/XAB) **Metal-containing polymers as fuel-cell catalysts. Final report, 27 September 1982-26 June 1986.** Reed, J.L. (Atlanta Univ., GA (USA). Dept. of Chemistry). 30 Jun 1987. 64p. NTIS, PC A04/MF A01.

Several aspects of the fuel-cell problem were addressed in this investigation. The objective was the development of a fuel-cell electrode-catalyst for use in a carbon monoxide fuel cell, which would utilize polymer-bound metal complexes as the catalytic species. Several commercially available polymers were examined to be used as backbones in the development of an electrode-catalyst. Polystyrene was chosen for more extensive study. The polymer was activated by complete or partial monochloromethylation of the pendant phenyls. Several schemes for binding cyclic tetradentate and bidentate ligands to the activated polymers were not obtained. The transition metals cobalt and nickel were incorporated into the polymers, and these new materials were examined. In addition, the electrochemical behavior of several metal complexes that hold potential as catalytic species was examined.

7563 (N—87-29914, pp vp) **Advanced fuel cell concepts for future NASA missions.** Stedman, J.K. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Studies of primary fuel cells for advanced all electric shuttle type vehicles show an all fuel cell power system with peak power capability of 100's of kW to be potentially lighter and have lower life cycle costs than a hybrid system using advanced $H_2O_2$ APU's for peak power and fuel cells for low power on orbit. Fuel cell specific weights of 1 to 3 lb/kW, a factor of 10 improvement over the orbiter power plant, are projected for the early 1990's. For satellite applications, a study to identify high performance regenerative hydrogen oxygen fuel cell concepts for geosynchronous orbit was completed. Emphasis was placed on concepts with the potential for high energy density (Wh/lb) and passive means for water and heat management to maximize system reliability. Both alkaline electrolyte and polymer membrane fuel cells were considered.

7564 (N—87-29914, pp vp) **Advances in solid polymer electrolyte fuel cell technology with low-platinum-loading electrodes.** Srinivasan, S.; Ticianelli, E.A.; Derouin, C.R.; Redondo, A. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

The Gemini Space program demonstrated the first major application of fuel cell systems. Solid polymer electrolyte fuel cells were used as auxiliary power sources in the spacecraft. There has been considerable progress in this technology since then, particularly with the substitution of Nafion for the polystyrene sulfonate membrane as the electrolyte. Until recently the performance was good only with high platinum loading (4 mg/sq cm) electrodes. Methods are presented to advance the technology by (1) use of low platinum loading (0.35 mg/sq cm) electrodes; (2) optimization of anode/membrane/cathode interfaces by hot pressing; (3) pressurization of reactant gases, which is most important when air is used as cathodic reactant; and (4) adequate humidification of reactant gases to overcome the water management problem. The high performance of the fuel cell with the low loading of platinum appears to be due to the extension of the three dimensional reaction zone by introduction of a proton conductor, Nafion. This was confirmed by cyclic voltammetry.

7565 (N—87-29914, pp vp) **Oxygen electrodes for rechargeable alkaline fuel cells.** Swette, L.; Giner, J. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Electrocatalysts and supports for the positive electrode of moderate temperature single unit rechargeable alkaline fuel cells were investigated and developed. The electrocatalysts are defined as the material with a higher activity for the oxygen electrode reaction than the support. Advanced development will require that the materials be prepared in high surface area forms, and may also entail integration of various candidate materials. Eight candidate support materials and seven electrocatalysts were investigated. Of the 8 support, 3 materials meet the preliminary requirements in terms of electrical conductivity and stability. Emphasis is now on preparing in high surface area form and testing under more severe corrosion stress conditions. Of the 7 electrocatalysts prepared and evaluated, at least 5 materials remain as potential candidates. The major emphasis remains on preparation, physical characterization and electrochemical performance testing.

7566 (N—87-29914, pp vp) **High-surface-area, dual-function oxygen electrocatalysts for space power applications.** Ham, D.O.; Moniz, G.; Taylor, E.J. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

The processes of hydration/dehydration and carbonation/decarbonation are investigated as an approach to provide higher surface area mixed metal oxides that are more active electrochemically. These materials are candidates for use as electrocatalysts and electrocatalyst supports for alkaline electrolyzers and fuel cells. For the case of the perovskite, $LaCoO_3$ , higher surface areas were achieved with no change in structure and a more active oxygen electrocatalyst.

7567 (N—87-29914, pp vp) **Theoretical performance of hydrogen-bromine rechargeable SPE fuel cell.** Savinell, R.F.; Fritts, S.D. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

A mathematical model was formulated to describe the performance of a hydrogen-bromine fuel cell. Porous electrode theory was applied to the carbon felt flow-by electrode and was coupled to theory describing the solid polymer electrolyte (SPE) system. Parametric studies using the numerical solution to this model were performed to determine the effect of kinetic, mass transfer, and design parameters on the performance of the fuel cell. The results indicate that the cell performance is most sensitive to the transport properties of the SPE membrane. The model was also shown to be a useful tool for scale-up studies.

7568 (PB—88-104641/XAB) **Electrochemical characteristics of acid electrolytes for fuel cells. Annual report, July 1986-June 1987.** Razaq, M.; Razaq, A.; Yeager, E. (Case Western Reserve Univ., Cleveland, OH (USA). Case Center for Electrochemical Sciences). Jul 1987. 102p. NTIS, PC A06/MF A01.

See also Annual report for Aug 1985-Jun 1986, PB—87-115283.

Electrochemical characterization of a number of perfluorinated acids was carried out with the emphasis on identification of alternate acids that could replace the presently used $H_3PO_4$ in the $H_2$-$O_2$ fuel cells. The activity for $O_2$ reduction in the perfluorinated acids on smooth Pt and on high-surface-area Pt catalyzed electrodes (10% Pt on Vulcan XC-72) was examined. The cathode potential for $O_2$ reduction in $CF_3PO(OH)_2$ and $(CF_3SO_2NHSO_3CF_2CF_2)_2$ is significantly higher than $H_3PO_4$. The perfluorinated acids with two terminal functional groups do not wet Teflon and could be very useful in the fuel cells. The solubilities and the diffusion coefficient of $O_2$ in the perfluorinated acids are higher than $H_3PO_4$; over an order of magnitude and a factor of 5 to 6, respectively. The specific conductivities of the dilute perfluorinated acids are higher than phosphoric acid, whereas the specific conductivities of the concentrated perfluorinated acids, particularly the imides, are lower than 85% phosphoric acid. A number of the perfluorinated acids with longer fluorocarbon tail(s) tested as additives in 85% $H_3PO_4$.

7569 **The synthesis of hydrogen cyanide in a solid electrolyte fuel cell.** Kiratzis, N.; Stoukides, M. (Dept. of Chemical Engineering, Tufts Univ., Medford, MA 02155). *Journal of the Electrochemical Society;* **134**: No. 8A, 1925-1928(Aug 1987).

The overpotential and product selectivity characteristics of the high temperature solid electrolyte fuel cell NH/sub 3/ CH/sub 4/, HCN, CO, N/sub 2/, Pt(Rh)ZrO/sub 2/(8% Y/sub 2/O/sub 3/ )Pt, air was studied at temperatures 800°-1000°C and atmospheric total pressure. The cell selectivity to HCN could exceed 75% with simultaneous generation of —0.01 W/cm/sup 2/ of electrical power. Electrochemical supply of oxygen to the fuel side has a positive effect on the cell selectivity to HCN. The cell is a promising candidate for the cogeneration of electric energy and hydrogen cyanide.

# 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

## 3201 Buildings

*REFER ALSO TO CITATION(S) 7403, 7531, 7588, 7837, 7838, 7842, 7849*

7570 **(AFME—83-1856) Building envelope thermics.** Bacot, P.; Neirac, F.; Neveu, A. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 109p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750596/JAW.

For their research on building thermics, the energetic center of the Ecole des Mines and the AFME (Energy conservation french agency) have developed three important tools: 1) a test building at real scale in Sophia Antipolis; 2) a building thermal simulator with a complex computer program for the precise analysis of heat transfers; 3) a mathematical model for the characterization of the building thermal inertia (modal analysis).

7571 **(EUR—10350) Measurement of air infiltration rates in large enclosures and buildings.** Potter, I.N.; Jones, T.J.; Dewsbury, J. (Commission of the European Communities, Luxembourg). 1985. 118p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750569/JAW.

This report describes work carried out as a research contract funded by the U.K. Department of the Environment and the Commission of the European Communities. To develop a validated method of measuring air infiltration rates in large single cell industrial buildings and to use the method to measure ventilation rates in selected buildings. The first stage was to determine the effects poor mixing would have on a selected tracer gas technique in interpreting the results; the second stage was to review advances in instrumentation technology: infra-red gas analysers were chosen. Thus a measurement system using infra-red gas analysers in conjunction with micro-computer controlled gas sampling assemblies was constructed to measure nitrous oxide tracer gas concentrations in thirty different zones and to measure up to thirty air temperatures. A test building was selected and sealed up to validate the measurement technique. Thirty different tests were undertaken. On average the measured ventilation rate was within ten percent of the known ventilation rate, despite imperfect mixing. A validated measurement system has thus been established and if the results of measurements undertaken here are typical, then the potential for energy savings attributable to ventilation heat loss in industrial buildings are very significant indeed.

7572 **(EUR—10433) Investigations of the performance of domestic central heating systems and of reductions in building fabric losses.** Rayment, R. (Commission of the European Communities, Luxembourg). 1986. 147p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750565/JAW.

A description of the characteristics of a pair of houses in Oxfordshire and a set of 8 houses in Cambridgeshire, specially instrumented, equipped with simulated occupancy and designed to provide an automatically operating test bed for accurately assessing energy conservation measures under realistic conditions, is presented. The description includes the constructional, thermal and air-infiltration properties together with the gas central heating systems and controls. On the basis of conditions simulated in the test houses and from laboratory studies the following findings are drawn: on the controls side: an electronic room-stat is shown to be potentially worthwhile, a flow switch used in conjunction with thermostatic radiator valves is recommended and weather compensator control is shown to be of doubtful value in such compact houses. For both pumped and gravity-fed domestic hot water services full cylinder-stat control of the hot water temperatures is shown to be cost-effective. Savings from secondary glazing and sealed double glazing units are discussed: more work is in hand to quantify the savings from the latter. Measurements of savings from 100 mm and 200 mm of loft insulation indicate that 200 mm is cost-effective in these houses. Good comparisons of actual energy consumption against those predicted from simple steady state calculations are shown where reliable information is available on the thermal properties of the buildings. Finally performance data for the switching operation of selected room-stat types has been measured in a specially constructed test-rig. This data has application in the computer simulation of these controls and in matching thermostats for experimental field use.

7573 **(EUR—10450) Investigation of the performance of various heating systems in a matched pair of houses.** Fuller, T.; Minogue, P.; Finn, M.; Carroll, D. (Commission of the European Communities, Luxembourg). 1986. 138p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750566/JAW.

The objective of this project was to reduce energy consumption in the domestic sector while maintaining or improving comfort conditions. The approach used was to evaluate a group of conventional heating and control systems under practical usage conditions in terms of their efficiency and overall performances. Having thus identified the deficiencies for each system, a number of innovations were introducted in an attempt to improve the performance of the systems and they were then retested.

7574 **(FRNC-TH—2293) Identification and control of a greenhouse: regulation and energy saving.** Meknassi, F. (Perpignan Univ., 66 (France)). 1983. 122p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88750599/JAW.

This paper deals with the temperature regulation in a greenhouse. The evolution of the system is described by a model and the effects of some unknown parameters on the temperature inside the greenhouse are studied. A simple linear discrete model is then proposed and identified by the means of a least squares method. A regulation algorithm is also developed, based on the synthesis of a numerical compensator. An optimum control law is then established for the night time and the early morning. Energy saving potentials are calculated.

7575 **(FRNC-TH—2306) Assisted energy management in dwellings: design, modelling and testing.** Berthoumieu, P. (Toulouse-3 Univ., 31 (France)). 1983. 147p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750594/JAW.

After a review of the potential of computer assisted design with personal computers for the gross design of architectural projects, this paper is concerned with the modellization of the thermal behaviour of a building. The program uses graphical data and the physical characteristics of the materials; the thermal balance of the building envelope is then simulated, the thermal conductivity being solely taken into consideration. The model is validated by an experimental study of the heat exchanges in a house.

7576 **(PB—88-102413/XAB) Performance characteristics of woodstoves under field conditions. Report for September 1985-September 1987.** Burnet, P.; Morgan, S.J.; McCrillis, R.C. (Coalition of Northeast Governors, Washington, DC (USA)). Sep 1987. 13p. NTIS, PC A03/MF A01.

This paper discusses data and preliminary findings from the first year of a 2-year detailed evaluation of woodstove performance characteristics under field conditions during tests on 32 volunteer houses in New York State and Vermont. Woodstoves were monitored for particulate emissions, wood-fuel use, and creosote accumulation in the chimney. Comparisons were made between stove technologies represented in the study houses: catalytic, high-efficiency noncatalytic, and conventional stoves. Add-on/retrofit catalytic devices added to conventional stoves were also evaluated. Field results showed that catalytic stoves achieved emission reductions of about 25%, compared to conventional stoves. Prior laboratory tests on the same catalytic stove models indicated reductions of 5 to 10 times were possible. High-efficiency noncatalytic technology, based on very limited data, showed the lowest average emission rates. Add-on/retrofit devices showed no emission reduction.

7577 **(PB—88-102462/XAB) Heat pump and appliance research: research status report, 1986-1987.** (Gas Research Inst., Chicago, IL (USA)). Sep 1987. 120p. (GRI—87/0255). NTIS, PC A06/MF A01.

This report details the status of work during 1986-1987 in the Heat Pump and Appliance Research Department of GRI in the areas of residential heating and cooling, residential heat pump and prime mover, commercial heat pump and prime mover, residential and commercial appliance, and building systems. Project information provided include contractor, GRI project manager, objectives, results to-date and status, and future plans. These research and development projects on gas end-use technology support GRI's objectives to develop improved gas-using equipment that is more effective, meets environmental standards, and offers competitive consumer costs at equivalent or higher quality of service compared with alternative energy-service options.

7578 **(PB—88-103528/XAB) Windows: fifth programme McKechnie Engineering (Reading) Ltd. Centurylite range product data.** (Property Services Agency, London (UK)). 1987. 31p. (MOB—08/615). NTIS, PC E05/MF E05.

A range of white uPVC windows reinforced with galvanized steel sections. Windows are for fixing into prepared openings, either flush edge or rebated. All frames are compatible and may be used singularly or coupled by horizontal and/or vertical members.

7579 **(PB—88-103577/XAB) Windows: fifth programme, James Gibbons Windows Ltd. Alpha, Concept and Iskotherm ranges product data.** (Property Services Agency, London (UK)). 1987. 52p. (MOB—08-624). NTIS, PC E06/MF E06.

Alpha and Concept are two ranges of aluminum windows using 45mm nonthermal break sections and the Iskotherm range of aluminum windows uses 64mm thermal break sections. Each range is offered with fixed and opening lights and their associated fittings and fixings for setting into prepared openings only. All frames are compatible and may be used singly or coupled horizontally or vertically. The Iskotherm range also offers Multilights.

7580 **(PB—88-113022/XAB) Feasibility of a complex compound heat pump. Annual report, July 1986-June 1987.** Rockenfeller, U. (Rocky Research Corp., Boulder City, NV (USA)). Jul 1987. 63p. NTIS, PC A04/MF A01.

This report describes the feasibility study of a double-effect gas-fired heat pump using ammoniated solid-vapor complex compounds as the working media. The cycle takes advantage of the coordinative characteristic of complex compound-ligand bonds resulting in large coordination spheres with only one degree of freedom. The cycle has high efficiency, no moving parts, and minimum electrical parasitic requirements. Fluid properties of candidate materials were measured with respect to vapor-pressure equilibria, coordination properties, and thermal stability. Preliminary reaction rate measurements were performed in adsorption and desorption processes. A computer model of double-effect cycle was developed in order to predict the operating performance of the candidate complex compound media. The computer model was used to determine preliminary heat balances and coefficients of performance, indicating COPc of about 1.0 and COPh of about 2.1 should be achievable.

7581 **(TVA/OP/CEM—87/36) Water source heat pump: How to get home heating and cooling from your own back yard.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Conservation and Energy Management). 1987. 10p. NTIS, PC A02. Order Number DE88900180/JAW.

This booklet discusses the advantages of using heat pumps to heat and cool houses. Water-source and ground-source heat pumps are described. (JDH)

7582 **(OA-Trans—2872) Trends in the specific consumption of domestic electrical appliances.** Kionka, U. Translated from *Elektrowaerme International, Edition A: Elektrowaerme im Technischen Ausbau ;* **45**: No. A2, 52-56(Mar 1987). 20p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900212/JAW.

Following the introduction in 1977 of product consumption data for domestic appliances, their consumption pattern from 1978 to 1985 was analysed by the ZVEI (Central Association of the Electrical Industry). Washing machines, dishwashers, cookers, refrigerators, freezers and how water storage tanks were studied. The energy savings over this period ranged from 15.7% cookers to 31.3% for hot water tanks. Domestic lighting was also examined and the economic advantage of fluorescent lighting over the conventional lightbulb is explained. 6 figs., 6 tabs.

7583 **(DOE-tr—7014927) Heterotrophic growth of alga.** Sikora, Z. (Instytut Zootechniki, Krakow (Poland); Algalogical Lab., Zator (Poland)). 1987. Translation of Wiadomosci Botaniczne; Vol. XIII, No. 2, 1969. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014927/JAW.

Whereas most algae can efficiently provide for most nutrient needs via photosynthesis, growth can be maintained in the dark or under conditions of low $CO_2$ tension provided a suitable carbon source is available. This paper describes the growth of Scenedesmus or chlorella on a variety of carbohydrates. 18 refs., 4 figs., 4 tabs. (DT)

## 3202 Transportation

7584 **(PB—87-231932/XAB) Research for public transit: new directions. Special report.** (National Research Council, Washington, DC (USA). Transportation Research Board). 1987. 159p. (TRB/TRR/SR—213). NTIS, PC A08/MF A01.

Library of Congress catalog card No. 87-22878.

The 8 papers in this report deal with the following areas: introduction; evolution of the public transportation industry; transit research: programs and priorities since 1962; developing a problem-solving transit research program; financing an operator-oriented research program; and managing and administering the research program.

7585 **(PB—88-102389/XAB) Private sector's role in public transportation in New York City: regulation and contracting. Technical report, September 1986-March 1987.** Sparrow, R.; Eichenthal, D. (New York Univ., NY (USA)). Jun 1987. 148p. NTIS, PC A07/MF A01.

This report examines the role of the privately owned and operated component of New York City's public-transportation system, including buses, vans, and taxis. Particular attention is given to the nature, rationale, and impact of governmental regulation of private carriers. Additionally, the report explores the potential for increased contracting by the Metropolitan Transportation Authority with private providers. The study found serious inadequacies in New York City's regulation of private transit companies, including harmful fragmentation of regulatory authority and unwarranted delays in the processing of applications. Tied to the regulatory framework is a bus-subsidization system which contains significant disincentives for good management, marketing, and financial practices. These failings have contributed to rider dissatisfaction with transit service as well as the development of extensive illegal and extralegal transit services such as unregulated buses, vans, and cabs.

7586 **(PB—88-103999/XAB) Information provision and passenger waiting times: an exploratory analysis of the effect of scheduled information on the efficiency of travel.** McKenzie, R.P. (Oxford Univ. (UK). Transport Studies Unit). 1986. 22p. (TSU/REF—353). NTIS, PC E03/MF E03.

The Transport Studies Unit was commissioned to investigate the trade-offs for urban bus operators in planning passenger information systems. As part of the research project, bus-stop interviews of prospective passengers were conducted in Aberdeen, Oxford, and the West Midlands. The aims of the surveys were: to compare passenger perception and knowledge of the public transport system with both the scheduled or planned service provision and also that occurring in reality; and to consider whether the provision of information is capable of significantly improving the efficiency of urban bus-trip making.

## 3203 Industry And Agriculture

*REFER ALSO TO CITATION(S) 7419, 7422, 7423, 7560, 7733, 7735, 7736, 7832*

7587 **(DOE/OR/00033—T352) Roles of electricity: Recent trends in manufacturing.** Burwell, C.C. (Oak Ridge Associated Universities, Inc., TN (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Mar 1987. Contract AC05-76OR00033. 19p. EPRI, 3412 Hillview Ave., Palo Alto, CA 94303. Order Number TI88001870/JAW.

This report presents data showing a trend towards increased use of electricity in various industries in the United States. Prices of fuels and electricity are compared. 47 refs., 8 figs., 7 tabs. (JDH)

7588 **(EUR—9557) Bituminous heat insulating materials.** Bocchi, L.; Castagnetta, V. (Commission of the European Communities, Luxembourg). 1986. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750567/JAW.

The project envisages energy savings in the heating of civil and industrial buildings with the use of improved insulating materials, e.g. waterproofed against humidity and water vapour and protected against the attack of polluting agents in the atmosphere, by means of bituminous products. The research aims at the utilization of any kind of granular or fibriform insulating material, where each individual element is completely coated with an impermeable and protective bituminous binder. The latter, as it also binds the elements together, makes possible the manufacture of insulating panels. The coating and manufacturing process can be performed by thoroughly mixing the insulating material with a relatively hot bitumen or with a cold bituminous emulsion and by pressing the mixture so as to form suitable panels. The report covers both the hot and the cold process, as well as the technical characterization of the bituminous heat insulating panels obtained.

7589 **(EUR—10087) Energy saving in the baking industry by more selective use of energy and by recovery of waste heat.** De Vries, L.; Nieman, W.; Rouwen, W. (Commission of the European Communities, Luxembourg). 1986. 43p. (In Dutch). Commission of the European Communities, Luxembourg.

Approximately 7000 Tj energy are used yearly by the bakery industry in the Netherlands. Until now, very little is known about energy use in this sector, this being partly due to the extremely decentralised production. The aim of the study is to pinpoint and evaluate methods for energy saving and heat recovery in the bakery. Priority was given to the procedures or places where a large amount of energy is used or is lost. A second important part of the study is to identify the situations where energy can easly be saved in very simple ways. The study was subsidised by the European Economic Community, the Industry group for bakeries and the Dutch Ministry for Economic Affairs. Monitoring was in the hands of a committee, with representation by the Nederlandse Bakkerijstichting (Dutch Bakery Organisation), the Stichting Voorlichting Energiebesparing Nederland (Organisation for Information about Energy Conservation), the Ministry of Agriculture/Fisheries and the Ministry of Economic Affairs.

7590 **(EUR—10652) Inedible rendering by means of the wet pressing process. Demonstration project.** (Commission of the European Communities, Luxembourg). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750563/JAW.

The rendering of offal and waste materials from slaughtering and meat processing is based traditionally on batchwise dry rendering followed by separation of meat and fat by means of solvent extraction. The energy consumption in such a process is high, i.e. of the order of 75 kg fuel oil per tonne raw materials having an average water content of nearly 60%. A new energy-saving process has been developed based on a conditioning and prepressing of the raw materials at temperatures of the order of 60/sup 0/C. The pressing procedure divides the materials into a solid phase with low fat content and a fluid phase containing more than 60% of the total water and nearly all the fat. The solid phase is dried in an indirectly heated drier. The fat from the fluid phase is removed in a tricanter. 80-90% of the water in the resulting liquid phase is removed in a three-stage vacuum evaporator using waste heat from the driers as heating medium. Pilot experiments have indicated that such a process is feasible and that the energy consumption in the process would be of the order of 35 kg fuel oil per tonne. The objective of the present project was to design and construct a full-scale production line using the wet pressing system, to demonstrate the feasibility of the process in full-scale operation and to obtain key figures for the energy consumption. The project was carried out at the Danish cooperative rendering plant KOFO in Losning. It was proven that the process - with minor modifications - is highly feasible in large-scale operation. The measuring of energy consumption showed the following figures: (i) 33.2 kg fuel oil per tonne offal or 60.1 kg per tonne water evaporated, and (ii) 69.1 kWh per tonne offal or 125 kWh per tonne water evaporated. An annual energy saving of 1632 toe was recorded for the wet pressing system compared to the conventional process formerly used at KOFO and based on a throughput of 50,000 t offal per year.

7591 **The $\mu$ interaction measure.** Grosdidier, P.; Morari, M. (Setpoint, Inc., Houston, TX 77079). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1193-1201(Jun 1987).

Multivariable controllers are often avoided in the chemical process industries in favor of simpler, diagonal or block-diagonal controllers. Such decentralized controllers are desirable because they result in control systems with fewer tuning parameters. However, the ensuing simplicity in controller design must be weighted against the interactions which result from ignoring the off-diagonal system blocks and which can lead to performance deterioration and even instability. One purpose of an Interaction Measure (IM) should be to indicate under what conditions the stability of the diagonal loops/blocks will guarantee that of the complete system. Using the notion of Structured Singular Value, the authors have derived a new dynamic IM for systems under feedback with diagonal or block-diagonal controllers.

## 3206 Municipalities And Community Systems

*REFER ALSO TO CITATION(S) 7166*

**7592 (DOE/CE/26550—T1) Feasibility study for district heating and cooling for the city of Des Moines, Iowa.** (Des Moines Engineering Dept., IA (USA); Iowa State Univ. of Science and Technology, Ames (USA). Design Research Inst.). [1987]. Contract FG01-86CE26550. 217p. NTIS, PC A10. Order Number DE88001713/JAW.

District heating and cooling are technically feasible, with the Iowa Power Plant as a primary energy source with cogeneration and three types of distribution media: high and low temperature water for heating and chilled water for cooling. District heating is economically feasible, but additional studies are needed for cooling. In general, district cooling should be considered mainly in addition to heating, except perhaps for small systems. To be economically feasible, the large consumer/producers (Capitol Complex, Drake University, and the four hospitals) should be included, and a strong marketing effort conducted to induce a large portion of major downtown buildings to join the system. To help in marketing, piping connections and system conversions in the buildings or groups of buildings should be included in the overall construction project and its financing. Further consideration should be given to construct the metro refuse burning plant as an additional energy source for district heating and cooling, or to have this function take place at the Iowa Power Plant with fluidized-bed boilers. The large consumer/producers can reduce the peak load conditions and enjoy reduced interruptible rates. The Iowa Gas Company could be considered as an alternate energy source, with a downtown location for a DHC plant. The City of Des Moines should proceed with Phase II, Site Specific Feasibility Study, in accordance with the tentative plan submitted, and seek funding for it.

**7593 (PB—88-102439/XAB) Characterization of household hazardous waste from Marin County, California, and New Orleans, Louisiana.** Rathje, W.L.; Wilson, D.C.; Lambou, V.W.; Herndon, R.C. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Sep 1987. 27p. NTIS, PC A03/MF A01.

There is a growing concern that certain constituents of common household products, that are discarded in residential garbage, may be potentially harmful to human health and the environment by adversely affecting the quality of ground and surface water. A survey of hazardous wastes in residential garbage from Marin County, California, and New Orleans, Louisiana, was conducted in order to determine the amount and characteristics of such wastes that are entering municipal landfills. The results of the survey indicate that approximately 642 metric tons of hazardous waste are discarded per year for the New Orleans study area and approximately 259 metric tons are discarded per year for the Marin County study area. Even though the percent of hazardous household waste in the garbage discarded in both study areas was less than 1%, it represents a significant quantity of hazardous waste because of the large volume of garbage involved.

## 3209 Education And Public Relations

*REFER ALSO TO CITATION(S) 7397*

**7594 (CONF-8706242—) NEED [National Energy Education Day] Project: Annual report and national recognition ceremonies.** (Energy Education Services, Inc., Reston, VA (USA)). Jun 1987. Contract FG01-85CE69196. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002726/JAW.

From 7. annual National Energy Education Day youth awards program for energy achievement; Arlington, VA, USA (20 Jun 1987).

"NEED" stands for National Energy Education Day. This short document reports on NEED awards, the impact of NEED, the national recognition ceremonies, and award-winning 1987 NEED school projects. (DLC)

# 33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

## 3301 Internal Combustion Engines

**7595 (PB—87-231122/XAB) Two-hole injector improves transient performance and exhaust emissions of 4-valve engines.** Iwata, M.; Osada, S.; Furuhashi, M.; Ujihashi, M. (Toyota Motor Co. Ltd., Aichi (Japan)). 1987. 12p. (In Japanese). NTIS, PC E07/MF A01.

Included in Toyota Engineering, Vol. 37, No. 1, 9-19(Jun 1987).

Of the main causes of the inadequate transient response of a 4-valve engine was established as being partition wall-wetting. The possibility of resolving this problem by improving fuel atomization was investigated. An air-mix type injector, although producing finer droplets with more uniform distribution, was not found effective in improving transient response. The development of a two-hole injector is described. This new injector produces twin sprays directed into the siamese intake ports without wetting the partition wall. As a consequence, the lean A/F ratio excursion is reduced, torque stumble is eliminated and the conversion efficiency of a three-way catalyst is increased.

**7596 Low NO/sub x/ combustor.** Taylor, J.R. (to Dept. of Energy, Washington, DC). US Patent 4,698,963. 13 Oct 1987. Filed date 22 Jul 1983. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a gas turbine engine, this patent describes a method of burning fuel in a combustor having a single fuel injection stage and having upstream and downstream portions, comprising the steps of: (a) generating, in an upstream annular first stage of the combustor, a burning fuel-air mixture which has a fuel-air equivalence ratio greater than unity and which is flowing downstream; (b) channeling the burning fuel-air mixture into an annular conduit located downstream of the first stage, the annular conduit (i) being defined by radially inner and radially outer walls and (ii) having an annular height less than the annular height of the annular first stage; (c) injecting substantially all quench air to be added to the fuel into the annular conduit through holes contained in the radially inner and outer walls of (b) (i) (i) for reducing the fuel-air equivalence ratio below unity, (ii) for causing the greatest rate of NO/sub x/ production to occur within the annular conduit; and (d) venting the burning fuel-air mixture mixed with quench air from the annular conduit of (c) to a second stage for further combustion.

**7597 Two-dimensional visualization of ignition kernels in an IC engine.** Loye, A.O.Z.; Bracco, F.V. (Dept. of Mechanical and Aerospace Engineering, Princeton Univ., Princeton, NJ 08544). *Combustion and Flame;* 69: No. 1, 59-70(Jul 1987).

Ignition kernels in a ported premixed-charge spark-ignition engine were examined using 2-dimensional visualization. A pulsed laser sheet was passed through the engine and the Mie scattering by the TiO/sub 2/ seeding particles was collected by a 100 x 100 pixel diode array with a field of view of 1 cm x 1 cm, and then digitized. The engine used a stoichiometric propane-air mixture and was operated at 300, 1200, and 3000 rpm. It is concluded that the turbulent flow field affected all the kernels examined, which included kernels as small as 2 mm and times after ignition as short as 100 μs. Increasing distortion and cycle-to-cycle variations in the ignition kernel with increasing engine speed were noted. Locally the flame front is often no thicker than the 200 μm resolution limit of the system. This implies that the turbulent flames are in the reaction sheet regime.

## 3307 Emission Control

*REFER ALSO TO CITATION(S) 7595, 7608*

7598 **(PB—88-101530/XAB) Summary and analysis of comments on the recommended practice for the measurement of refueling emissions. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). Mar 1987. 130p. NTIS, PC A07/MF A01.

See also report dated Aug 85, PB—86-102282.

As a result of concerns about the emissions that occur when gasoline vapors are displaced from fuel tanks during the refueling of motor vehicles, EPA has been examining the need for the control of these refueling emissions and the methods to do so. One such method involves the collection on the vehicle of the displaced hydrocarbons and the measurement of the effectiveness of the refueling vapor control system. The type of control is referred to as onboard control of refueling emissions. The report presents a summary of the comments on the recommended refueling test procedure, EPA's analysis of the issues raised by the commenters, and the resulting changes made to the recommended test procedures.

7599 **(PB—88-102603/XAB) Safety implications of onboard refueling vapor-recovery systems. Technical report (Final).** (Environmental Protection Agency, Ann Arbor, MI (USA)). Jun 1987. 103p. (EPA/AA/SDSB—87/05). NTIS, PC A06/MF A01.

See also PB—86-102282.

This report evaluates the safety implications of requiring onboard refueling vapor recovery systems on gasoline-powered passenger cars, light trucks, and heavy-duty vehicles. Special attention is given to the analysis of the design considerations for a safe onboard system and other measures necessary to insure that the design considerations incorporated are capable of providing a high level of in-use fuel-system integrity. Concerns over the potential safety implications of onboard systems were raised. These concerns can be grouped into four general areas. These include requirements to pass the National Highway Traffic Safety Administration (NHTSA) safety test, the effects of tampering and system defects, refueling operations, and in-use fuel system safety. All of these concerns are presented as well as design considerations for a safe system. In-use fuel system safety is also presented as well as cost and lead-time considerations for implementating a safe system.

7600 **(PB—88-102611/XAB) Investigation of the need for in-use dispensing-rate limits and fuel-nozzle geometry standardization. Technical report.** (Environmental Protection Agency, Ann Arbor, MI (USA)). May 1987. 23p. (EPA/AA/SDSB—87/07). NTIS, PC A03/MF A01.

The report presents the results of the investigation of the effects of dispensing rates and fuel-nozzle geometries on motor-vehicle refueling emissions. It also supports EPA's proposal to regulate in-use dispensing rates and further study the need for some form of gasoline-nozzle standardization.

7601 **(PB—88-102629/XAB) Discussion of possible causes of low failure rates in decentralized I/M (inspection/maintenance) programs. Technical report.** Tierney, E.J. (Environmental Protection Agency, Ann Arbor, MI (USA). Technical Support Staff). Jan 1987. 33p. (EPA/AA/TSS/IM—87/1). NTIS, PC A03/MF A01.

This report reviews six possible explanations for low reported failure rates in manual, decentralized Inspection/Maintenance (I/M) programs. The report analyzes and discusses random roadside idle survey data, reported I/M program data, and data collected during audits of I/M programs. The data indicate that five of the explanations: quality control, fleet maintenance, differences in fleet mix or emission standards, anticipatory maintenance, and pre-inspection repair, do not sufficiently explain low reported failure rates. The report concludes that the major problem contributing to low reported failure rates in decentralized, manual, I/M programs is improper inspections by test station personnel.

7602 **(PB—88-104344/XAB) Preliminary evaluation of a method using an FID (flame ionization detector) for measurement of methanol in auto emissions. Final report.** Gabele, P.A.; Ray, W.D.; Duncan, J.; Burton, C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Sep 1987. 17p. (EPA—600/3-87/035). NTIS, PC A03/MF A01.

This report evaluates a simplified technique for estimating methanol emission rates in auto exhaust. The technique, referred to as the FID Bubbled Method or FBM, is based in principle on the fact that, while hydrocarbons are not readily absorbed in water, methanol is. Hence, by using a heated flame ionization detector to measure the organic mass in samples before and after bubbling them in water, the quantity of methanol originally present can be estimated by taking the difference between the measurements. Evaluation of the method was done by comparing methanol measurements using the FBM with measurements made using an established reference method. Results showed poor to fair agreement between the two methods. The FBM appeared better at estimating methanol emission rates from evaporative tests than from exhaust tests and also exhibited better accuracy for samples containing higher levels of methanol.

## 3308 Alternative Fuels

*REFER ALSO TO CITATION(S) 7307, 7309, 7312*

7603 **(PB—88-101506/XAB) Evaluation of emissions from low-mileage catalysts on a light-duty methanol-fueled vehicle. Technical report.** Piotrowski, G.K. (Environmental Protection Agency, Ann Arbor, MI (USA)). Apr 1987. 50p. (EPA/AA/CTAB—87/05). NTIS, PC A03/MF A01.

This report describes the results of testing methanol catalyst in a two-phased program. Phase I involved the use of base-metal or lightly loaded noble-metal catalysts in three-way and oxidation-catalyst modes. Phase II involved the use of heavily loaded noble-metal catalysts in an effort to reduce hydrocarbon and aldehyde emissions to very low levels.

# 36 MATERIALS

## 3601 Metals And Alloys

*REFER ALSO TO CITATION(S) 7208, 7643, 7662, 7691, 7806, 8166, 8181, 8182*

7604 **(AD-A—184639/3/XAB) Two-dimensional connectivity of liquid-phase-sintered microstructures.** German, R.M. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). May 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Metallurgical Transactions A, Vol. 18A, 909-914(May 1987).

Liquid-phase-sintered materials are characterized by a connected microstructure composed of contacting grains in a solidified matrix phase. Observations on the sintered microstructure are typically performed using two-dimensional cross sections. A computer calculation was performed to determine the variation in the observed contacts per grain vs the true underlying microstructure connectivity. The results show that the observed coordination depends on both the volume fraction of solid phase and the dihedral angle. The findings of the calculation are favorably compared with observations on Fe-Cu and W-Ni-Fe alloys. In the limiting case, the current calculations approach those found for polycrystalline solids and cell networks.

7605 **(AGARD-LS—154) Superplasticity.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Aug 1987. 201p. (CONF-8709197—; CONF-8709198—; CONF-8709199—). NTIS, PC A10/MF A01.

From Superplasticity conference; Dayton, OH, USA (8 Sep 1987).

Several topics relating to superplasticity in metals are discussed. Superplastic sheet forming, bulk forming of superplastic alloys, cavitation and superplasticity, diffusion bonding of metals, mechanical properties of superplastically formed titanium and aluminum alloys, and designing for superplastic alloys are among the topics covered.

7606 (AGARD-LS—154, pp vp) **Manufacture of superplastic alloys.** Grimes, R. Aug 1987. NTIS, PC A10/MF A01. (CONF-8709197—; CONF-8709198—; CONF-8709199—).

From Superplasticity conference; Dayton, OH, USA (8 Sep 1987).

Amongst aluminum alloys, the Al-6 percent Cu-0.4 percent Zr system that typifies the Supral alloys requires a specially developed casting system in order to achieve a very high level of supersaturation with zirconium. Subsequent manufacturing is fairly conventional, the sheet product recrystallizing dynamically during superplastic forming. The higher strength aluminum alloys are conventionally cast but achieve a very fine grain size at sheet stage by careful thermal mechanical treatment during the later stages of semi-fabrication. With titanium, the standard production route for the Ti-6Al-4V alloy results in a product with superplastic capabilities perfectly adequate for most applications.

7607 (CONF-871235—1) **Dislocation free zone model of fracture under reverse loading.** Chang, S.J.; Ohr, S.M. (Oak Ridge National Lab., TN (USA); State Univ. of New York, Stony Brook (USA). Dept. of Materials Science and Engineering). 1987. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002676/JAW.

From Colloquia on modern topics in mechanics; Evanston, IL, USA (4 Dec 1987).

We examined the effect of reverse loading and anti-shielding on the local stress intensity, and size of DFZ and the associated distribution functions of dislocations. It was shown in the numerical results that during reverse loading two distinct equilibrium distributions of dislocations are possible solutions to the pileup integral equation but these distributions result in different local stress intensity factors. The true distribution can be selected from the two if the local stress intensity factor is limited by the reversed critical stress intensity factor for dislocation emission -K/sub g/. The negative dislocations generated during reverse loading or cyclic loading lead to crack growth. 21 refs., 5 figs.

7608 (DOE/ER/10485—T5) **Studies of supported metal catalysts: Final report for the period May 1, 1984 to April 30, 1987.** Hercules, D.M. (Pittsburgh Univ., PA (USA). Dept. of Chemistry). Apr 1987. Contract AC02-79ER10485. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002546/JAW.

Methodology has been developed to use ESCA for quantitative measurement of the distribution of species on catalyst surfaces. Additionally, the quantitative aspects of Raman spectroscopy have been explored, and the technique has been used to supplement quantitative ESCA measurements. The role of additives on the structure of catalysts has been studied. Specifically, we have investigated the effect on the isoelectric point of the support and thus the effect on catalyst preparation. Detailed studies have been completed on the effect of B and Ti on the state, dispersion, and reactivity of $Co/Al_2O_3$ and $Ni/Al_2O_3$ catalysts, respectively.

7609 (DOE/ER/45184—3) **The influence of grain boundary chemistry and structure on the intergranular attack and intergranular stress corrosion cracking of austenitic alloys: Progress report, August 1, 1986-July 31, 1987.** Was, G.S. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Oct 1987. Contract FG02-85ER45184. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002436/JAW.

Brief descriptions and results are presented for the following areas: (1) grain boundary studies which were performed in order to determine the effects of B on microstructure and intergranular precipitation in Ni-16Cr-9Fe-C alloys; (2) stress corrosion cracking in high purity water and caustic solutions in Inconel 600, AFU188, and AFU41 alloys; (3) simulations on model grain boundaries of Ni-16Cr-9Fe with and without hydrogen. 11 refs., 2 figs., 10 tabs. (CBS)

7610 (ESA-SP—256) **Proceedings of the sixth European symposium on material sciences under microgravity conditions.** Burke, W.R. (European Space Agency, 75 - Paris (France)). Feb 1987. 617p. (ETN—87-90484; CONF-8612114—). NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100.

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

Critical phenomena in microgravity materials processing; fluid physics; glass; industrial perspectives; melt growth; solution growth; space instrumentation; transport phenomena; and vapor growth were discussed.

7611 (ESA-SP—256, pp vp) **Grain boundary grooving of Al-bicrystals in the presence of a liquid Al-In alloy.** Ratke, L.; Vogel, H.J. Feb 1987. NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100. (ETN—87-90484; CONF-8612114—).

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

Grain boundary grooving of the Al bicrystal by diffusion of Al through an In-rich liquid was investigated at different temperatures below the monotectic. An instability of the groove profile is observed leading to a completely different groove profile than theoretically predicted by the theory of Mullins. The occurrence of this instability is explained by the existence of a second process disturbing the groove kinetics: grain boundary diffusion of In atoms into the bicrystal boundary.

7612 (ESA-SP—256, pp vp) **Oscillatory buoyancy-driven flow in horizontal liquid-metal layers.** Benhadid, H.; Roux, B. Feb 1987. NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100. (ETN—87-90484; CONF-8612114—).

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

A two dimensional numerical simulation of the onset of oscillations in horizontal liquid-metal layers (0 is less than Pr is less than 0.1) is described. Layers with upper free surface are treated in order to model horizontal (Bridgman) solidification boat. When this upper surface is assumed conducting, oscillations are found for Pr=0, 0.015, 0.03, and 0.1, when Gr exceeds a critical value, Gr(c,osc). Gr(c,osc) increases with Pr. For Pr=0.03, these oscillations are found to only exist in a limited range of GR (GR(c,oec) is less than or = Gr is less than or = 2 Gr(c,osc)); they are damped when Gr is increased beyond this range. This restabilization phenomenon is not explained. A correlation is found for the theoretical and experimental values of the oscillation frequency in terms of Gr, in the ranges 2 is less than or = Az is less than or = 8 and 0.015 is less than or = Pr is less than or = 0.07. This correlation also includes damped frequencies found in subcritical regimes.

7613 (ESA-SP—256, pp vp) **Numerical study of the perturbation of Soret experiments by three-dimensional buoyancy driven flows.** Henry, D.; Roux, B. (Institut de Mecanique des Fluides de Marseille, France). Feb 1987. NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100. (ETN—87-90484; CONF-8612114—).

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

Buoyancy driven convection arising in a fluid mixture confined in a cylindrical container designed for a measurement of the Soret coefficient of a binary mixture, was investigated. The convective motions and their effect on Soret separation were determined for Soret experiments performed in space or on Earth. The results are used to interpret more accurately the Soret experiments.

7614 (ESA-SP—256, pp vp) **Thermodynamic and kinetic study of a Vapor Phase Transport (VPT) reaction: the system NbSe2-iode.** Vacquier, G.; Casalot, A. Feb 1987. NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100. (ETN—87-90484; CONF-8612114—).

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

Kinetic and 'hermodynamic studies are used to investigate chemical vapor transport of niobium diselenide by iodine processes. A kinetic study, operated in a multizone furnace, strongly depends on thermal profile (2 or 3 zones), on available $NbSe_2$ mass, on initial iodine concentration, and on flux perturbations. Biggest crystals are obtained in the 3 zones profile with a 7.8 mg/hr transport speed. A thermodynamic study of transport was done from total pressure measurements of $NbSe_2$ + iodine mixing. The behavior of iodine, selenium, and niobium diselenide under the same conditions shows that iodine and selenium dissociations both occur with high temperature $NbI_3$ iodide formation. Equilibria temperature is close to 740 +/- 10C.

7615 (FhG-W—2/87) **Fracture mechanics characterization of crack growth under creep and fatigue conditions. Final report.** Hollstein, T.; Kienzler, R. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 13 Mar 1987. 88p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751269/JAW.

Based on theoretical considerations and experimental evidence, several concepts have been investigated to correlate crack growth under high-temperature conditions with material parameters of fracture mechanics, e.g., stress-intensity factor K, and line integrals J and C/sup */. It could be shown for different materials that these parameters describe the behavior of cracks independent of geometry and loading conditions within certain limits of validity. The laboratory results then can be transferred to real structures for (residual) lifetime predictions or safety analyses (Incoloy 800H, Thermon 4972, 9% chromium steel). With 45 refs., 3 tabs., 56 figs..

7616 (LA—11170-MS) **The effects of vibration and electromagnetic forces on casting: A literature review.** Young, K.M. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002721/JAW.

Vibration of electromagnetic stirring during casting can improve the fluidity of the melt, the grain size, and the surface finish of the product, and it can contribute to degassing. The amount of grain refinement should be more substantial when ultrasonic vibration is used instead of impulse vibration, which is in turn superior to low-frequency vibration. Oscillation rotation and horizontal circular vibration are newer techniques currently being developed. Application of an electric field or pulse discharge during casting is another method used to affect the solidification of the molten metal. 20 refs.

7617 (LA-UR—87-3619) **Computer simulation of pencil glide in bcc metals.** Rollett, A.D.; Kocks, U.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8708162—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001802/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Aug 1987).

An existing computer code for simulation of texture development in polycrystals has been modified to model "pencil glide" as observed in some bcc metals. Pencil glide can be thought of as a limiting case where the slip direction is restricted to [111] directions but the slip plane is arbitrary. The existing code simulates "restricted glide", i.e., [111](110) slip systems, by using the Bishop-Hill method to find the ative vertex of the single crystal yield surface for each grain. It then corrects this trial solution by using a nonlinear viscous law based on the total [111]-resolved stress component. Only a small increase in computation time required is required compared to restricted glide. The results of the pencil glide modification of the code are that the texture development in tension is essentially the same as for restricted glide but that significant differences appear in plane strain compression (rolling). The Taylor Factor in tension for a random polycrystal is found to be 2.74. 20 refs., 5 figs., 1 tab.

7618 (LBL—24073) **Non-phonon mechanisms of superconductivity in high T/sub c/ superconducting oxides and other materials and their manifestation.** Kresin, V.Z. (Lawrence Berkeley Lab., CA (USA)). Jun 1987. Contract AC03-76SF00098. 15p. (CONF-870682—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002708/JAW.

From Workshop on novel mechanisms for superconductivity; Berkeley, CA, USA (22 Jun 1987).

Low dimensionality and the unusual parameter values in the high T/sub c/ materials lead to a key contribution of the plasmon mechanism of superconductivity. In addition, these systems provide a unique opportunity to observe a multigap structure. The problem of the lattice instability is discussed. A manifestation of non-phonon mechanisms (NPM) in $Nb_3Ge$ and the contribution of the intramolecular vibrations are analyzed. Proximity systems containing high T/sub c/ superconductors are promising from the point of view of possible applications. 48 refs.

7619 (LBL—24074) **Microstructure and magnetic properties of cobalt-chromium alloys.** Chan, L.H. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002762/JAW.

Microstructural details and magnetic properties of Co-Cr in the thin film form are being extensively investigated. It is also worthwhile to consider Co-Cr as a metallurgical system. Objectives of this study were to investigate: the microstructural evolution of these alloys as function of Cr content; the magnetic properties of these alloys as function of Cr content and to extend this understanding to elucidate the microstructure/property correlations. It was found that Cr additions enhanced the fcc phase retention and subsequently the fault density. The additions also decreased saturation magnetization and grain size. Furthermore, the intrinsic coercivity was fairly insensitive to Cr additions for a given grain size and the coercivity increased with decreasing grain size. 35 refs., 36 figs., 2 tabs.

7620 (N—87-28643) **Thermal fatigue tests of a radiative heat shield panel for a hypersonic transport.** Webb, G.L.; Clark, R.K.; Sharpe, E.L. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1985. 31p. (NASA-TM—87583; NAS—1.15:87583). NTIS, PC A03/MF A01.

A pair of corrugation stiffened, beaded skin Rene 41 heat shield panels were exposed to 20,000 thermal cycles between room temperature and 1450 F to evaluate the thermal fatigue response of Rene 41 metallic heat shields for hypersonic cruise aircraft applications. At the conclusion of the tests, the panels retained substantial structural integrity; however, there were cracks and excessive wear in the vicinity of fastener holes and there was an 80-percent loss in ductility of the skin. Shrinkage of the panel which caused the cracks and wear must be considered in design of panels for Thermal Protection Systems (TPS) applications.

7621 (N—87-28944) **Exposure time considerations in high temperature low cycle fatigue.** Kalluri, S.; Manson, S.S.; Halford, G.R. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1987. 12p. (NASA-TM—88934; E—3375; NAS—1.15:88934; CONF-8706235—). NTIS, PC A02/MF A01.

From 5. international conference on mechanical behaviour of materials; Beijing, China (3 Jun 1987).

The Conventional Strainrange Partitioning (CSRP) method for High-Temperature, Low-Cycle Fatigue (HTLCF) life prediction has its origins in the modeling of first-order, creep-fatigue waveform effects while treating as second-order effects, the influence of metallurgical or environmental time dependencies. Procedures are proposed to include the latter explicitly in the inelastic strainrange–life relations. For brevity, only the CP life relation will be presented in detail. The exposure-time effect within the CP inelastic strainrange (tensile creep reversed by compressive plasticity)

was determined by tensile stresshold-time experiments for 316 SS at 816 C. Reductions in CP cyclic life of a factor of about two were observed with an increase in exposure time or a corresponding decrease in creep rate by a factor of about 100. The CP life relation has been modified to be expressed in terms of either Steady State Creep Rate (SSCR) or Exposure Time (ET). The applicability and accuracy of the time-dependent CP life relations is demonstrated by conducting verification experiments involving complex hysteresis loops. Metallographic examination revealed time-dependent degradation attributable to oxide formation and precipitation of carbides along grain boundaries.

7622 **(SAND—87-8242) The effect of deformation rate on JBK-75 stainless steel forgings.** Odegard, B.C. (Sandia National Labs., Livermore, CA (USA)). Oct 1987. Contract AC04-76DR00789. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001696/JAW.

A parametric study was conducted to evaluate the effect of forging rate and forging temperature on the strength and microstructure of a precipitation-hardened, austenitic stainless steel forging. High and low forging rates were achieved using a high energy rate forging (HERF) process and a low velocity mechanical press (MP) respectively. The forging geometry required a two-stage forging sequence. The first stage or preform was identical for both forging processes. The final stage used similar die geometries with minor modifications to accommodate the attachment to the respective hammers. The resulting microstructure and mechanical properties were significantly different. These differences are attributed to the effects of strain rate and temperature. 10 figs., 1 tab.

## 3602 Ceramics, Cermets, And Refractories

*REFER ALSO TO CITATION(S) 7610, 7618, 7637, 7805*

7623 **(AD-A—184754/0/XAB) Defect characterization in quartz and related materials. Final report, April-December 1983.** Halliburton, L.E.; Martin, J.J.; Sibley, W.A.; Powell, R.C. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). Jun 1987. 150p. NTIS, PC A07/MF A01.

Availability: Document partially illegible.

The substitutional aluminum ions present in all quartz require charge compensation. In as grown synthetic quartz, interstitial alkalis serve as the charge compensators. Irradiation at temperatures above 200 K replaces the alkali with either a proton or a hole trapped on an adjacent oxygen. Electrodiffusion (sweeping) can be used to replace the alkali with either a proton or another specific alkali. A study of the acoustic loss of a series of 5-MHz fifth overtone AT-cut resonator blanks as a function of sweeping and irradiation was completed. No acoustic-loss peaks were observed at temperatures less than 100 C, which could be attributed to either the Al-Li or Al-OH centers. Na-swept samples showed the expected large loss peak at 53 K while unswept samples had only very small 53 K peaks. This result shows that in as-grown quartz, lithium is the primary charge-compensating ion. Irradiation removed the 53 K peak and introduced new peaks at 23, 100, and 135 K. During anneal, these peaks were found to track with the Al-hole center.

7624 **(CONF-871210—1) Techniques for ceramic sintering using microwave energy.** Kimrey, H.D.; Janney, M.A.; Becher, P.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001416/JAW.

From 12. annual international conference of the Institute of Electrical and Electronics Engineers on infrared and millimeter waves; Orlando, FL, USA (14 Dec 1987).

The use of microwave energy for ceramic sintering offers exciting new possibilities for materials processing. Based on experience gathered in microwave processing associated with the heating of fusion plasmas, we have developed hardware and methods for uniformly heating ceramic parts of large volume and irregular shape to temperatures in excess of 1600°C, in vacuum or pressurized atmosphere. Microwave processing at 28 GHz yields enhanced densification rates with a corresponding reduction in sintering temperatures. 6 refs.

7625 **(DOE/CE/90227—1) Tribological studies on high speed steel cutting tools: Final report.** Lin, P.; Deshpandey, C.; Doerr, H.J.; Bunshah, R.F. (California Univ., Los Angeles (USA). Dept. of Materials Science and Engineering). Sep 1987. Contract AC02-84CE90227. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002550/JAW.

Carbide and nitride coatings of Ti, Zr and Hf were prepared using the Activated Reactive Evaporation process. The effect of deposition conditions on structure and properties of these coatings was evaluated. Optimum deposition conditions to obtain high values of microhardness in the coatings were established. High-speed steel cutting tools were coated under the respective optimum conditions and were tested for cutting performance. Results indicated that the coated inserts performed significantly better than uncoated inserts. ZrN coated inserts showed the best performance. Preliminary work was also carried out to synthesize (TiAl)N and (TiAl)C coatings. Coatings in the composition range (Ti/Al) between 80:20 to 30:70 were prepared. X-ray diffraction studies on the (TiAl)N coatings showed major peaks corresponding to TiN and very small peaks corresponding to AlN phase. Similarly (TiC) was found to be a major phase in (TiAl)C coatings. The microhardness of the coatings varied depending on their composition. Lower values observed for the microhardness of these coatings are believed to be due to the very small thickness of the coatings, (~1 μm) for a 50 g load used in the hardness measurements.

7626 **(ECN—199) Microscopic examinations of a sphere-pac and a pellet UO/sub 2/ fuel rod, irradiated during 1530 days in the Dodewaard BWR.** Linde, A. van der. (Netherlands Energy Research Foundation, Petten). Jul 1987. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700786/JAW.

Seventy sphere-pac and seventy standard pellet UO/sub 2/ fuel rods operated simultaneously without failures in the Dodewaard BWR at axial average powers of 16-20 kW/m up to axial average burnups of 16-30 MWd/kg UO/sub 2/. Peak powers were about 43 kW/m and occurred early in life at about 2 MWd/kg UO/sub 2/. Peak burnups were 36 MWd/kg UO/sub 2/. The non-destructive post-irradiation examinations, reported earlier, resulted in the conclusion that the measured differences between sphere-pac and pellet UO/sub 2/ rods were in effect insignificant. The destructive post-irradiation examinations, in particular optical microscopy, SEM and EPMA on rod cross sections, exhibited some significant differences between sphere-pac and standard pellet UO/sub 2/ rod behaviour during normal operation in the Dodewaard BWR. The extent of UO/sub 2/ sintering and of outward movement of cesium in the central region of the fuel column were substantially smaller in the sphere-pac rod. The absence of an as-fabricated fuel-cladding gap in sphere-pac rods results in lower central fuel temperatures than in pellet rods, at least during the early in life period when the amount of released fission gas is still small. The presence of radial cracks in the outer, not sintered, regions of the pellet fuel column constitute direct paths for outward transport of volatile fission products from the hot sintered central region towards the inner cladding surface. This makes pellet rods sensitive for stress corrosion cracking of the zircaloy cladding wall. 20 figs.; 13 refs.; 13 tabs.

7627 (ESA-SP—256, pp vp) **Thermodynamic model for chemical transport reactions and some results in the Ru/sub x/-V/sub 1-x/$O_2$-Delta/$TeCl_4$-system studied under diffusive-convective conditions.** Krabbes, G.; Gerlach, U.; Wolf, E.; Reichelt, W.; Oppermann, H.; Launay, J.C. Feb 1987. NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100. (ETN—87-90484; CONF-8612114—).

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

Chemical vapor transport (CVT) of multicomponent compounds accompanied by a shift of composition between source and crystals, predicted by an one-dimensional model with thermodynamic boundary conditions, was investigated for RuxV/sub 1-x/$O_2$-delta with $TeCl_4$ as transport agent under ground conditions. The enhanced convective flow caused either by higher amounts of $TeCl_4$ or by Ar inert gas influences the transport rate but also the extent of the observed composition shift. Thus the predicted shift of

the composition is confirmed, but under ground conditions it is affected by convective flow.

**7628 (UCRL—95286) 1064 nm and 350 nm laser damage thresholds of high index films deposited from organic solutions and sols.** Thomas, I.; Wilder, J.; Gonzales, R.; George, D. (Lawrence Livermore National Lab., CA (USA)). 30 Jun 1987. Contract W-7405-ENG-48. 14p. (CONF-8710165—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001636/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

High index oxide coatings $TiO_2$, $Ta_2O_5$, $ZrO_2$ and $HfO_2$ have been prepared from organic solutions of metal organic precursors or from colloidal oxide suspensions. Room temperature processing gives porous coatings of comparatively low index (1.8 to 1.9). Heat treatments can, in some cases, increase the index. Laser damage threshold levels at 1064 nm with a single 1 ns pulse are in the range 6 to 10 J/cm$^2$. Lower figures are obtained at 350 nm with a 25 ns pulse under multishot (25 Hz) conditions. 7 refs., 6 figs.

**7629 (N—87-28608) Silicon carbide sintered body manufactured from silicon carbide powder containing boron, silicon and carbonaceous additive.** Tanaka, H. (National Aeronautics and Space Administration, Washington, DC (USA)). Aug 1987. Translation of Japanese Patent no. 55020269 (13 Feb. 1980) 5p. (NASA-TT—20105; NAS—1.77:20105). 14p. NTIS, PC A02/MF A01.

A silicon carbide powder of a 5-micron grain size is mixed with 0.15 to 0.60 wt% mixture of a boron compound, i.e., boric acid, boron carbide ($B_4C$), silicon boride ($SiB_4$ or $SiB_6$), aluminum boride, etc., and an aluminum compound, i.e., aluminum, aluminum oxide, aluminum hydroxide, aluminum carbide, etc., or aluminum boride ($AlB_2$) alone, in such a proportion that the boron/aluminum atomic ratio in the sintered body becomes 0.05 to 0.25 wt% and 0.05 to 0.40 wt%, respectively, together with a carbonaceous additive to supply enough carbon to convert oxygen accompanying raw materials and additives into carbon monoxide.

**7630 Radiation effects in actinide host phases.** Weber, W.J.; Matzke, H.J. (Pacific Northwest Lab., Richland, WA, USA; Commission of the European Communities, Karlsruhe, Germany, F.R. European Inst. for Transuranium Elements). *Radiation Effects;* **98**: No. 1-4, 93-99(Sep 1986). (CONF-8507164—).

From 3. international conference on radiation effects in insulators; Guildford, UK (15 Jul 1985).

Three crystalline ceramic materials, which occur as host phases for the long-lived actinides in many nuclear waste formulations, were doped with Cm-244, and the effects of self-radiation damage from alpha decay on microstructure and physical properties were investigated. The irradiation-induced microstructure consists of individual amorphous tracks from both the alpha-recoil particles and the spontaneous fission fragments. The overlap of the tracks at higher doses leads to a completely amorphous state at a cumulative dose of 1.3-2.3 x $10^{25}$ alpha decays/m$^3$. This radiation-induced amorphization process results in a stored energy of approx. 128 J/g, 5-10% swelling, factor of 10-50 increase in leachability, and an increase in fracture toughness.

## 3606 Other Materials

*REFER ALSO TO CITATION(S) 7153, 7154, 7155, 7155, 7173, 7174, 7179, 7179, 7187, 7294, 7387, 7387, 7387, 7630, 7701, 7804, 7805*

**7631 (AD-A—184504/9/XAB) Spin-orbit scattering time and dephasing time of carriers in two-dimensional HgTe-CdTe superlattices and heterojunctions.** Moyle, J.K.; Cheung, J.T.; Ong, N.P. (Princeton Univ., NJ (USA). Dept. of Physics). 15 Apr 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Physical Review B, Vol. 35, No. 11, 5639-5646(15 Apr 1987).

Weak-localization studies of the two-dimensional electron gas in heterostructures made of HgTe adn CdTe are reported. Because of the small effective mass, the diffusion constant D is unusually large (824 sq. cm/s). By fitting the weak-field transverse magnetoresistance data from high-mobility samples (50,000 sq. cm/Vs, R = 720 ohms/unit area to the calculation of Hikami, Larkin, and Nagoka, the authors determined the temperature (T) dependence of the spin-orbit scattering time and the dephasing time of carriers. The system is shown to have dominant spin-orbit scattering. (The spin-orbit rate is 0.6 times the elastic scattering rate.) The dephasing time which is linear in T agrees in magnitude with a calculation by Al-tshuler, Aronov, and Khmel'nitskii. Evidence for significant Coulomb interaction parameter derived from the plot of the resistance versus in T strongly disagrees with existing theories. Prominent anomalous magnetoresistance is also seen in the longitudinal geometry. The data are compared with the interaction theory (Zeeman splitting) and the weak-localization theory. Results from high-resistance (30 kilo ohm/unit area) samples which indicate the breakdown of perturbation theory are also reported.

**7632 (AD-A—184527/0/XAB) Determination of the accessibility of N-H groups of Kevlar 49 fibres by photoacoustic FTi.r. spectroscopy.** Chatzi, E.G.; Urban, M.W.; Ishida, H.; Koenig, J.L. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Macromolecular Science). Dec 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Polymer, Vol. 27, 1850-1854(Dec 1986).

Fourier transform infrared (FTi.r.) photoacoustic spectroscopy in combination with deuterium exchange was used to determine the accessibility of the N-H groups of Kevlar 49 fibres. The spectra were corrected for the dependence of the photoacoustic signal on the frequency and the integrated intensities of the N-H and N-D stretching bands were used to calculate the fraction of accessible N-H groups. Exposure of the deuterated fibers to saturated water vapor showed a residual N-D stretching absorption, in agreement with the improved molecular packaging expected after heat treatment at high temperature.

**7633 (AD-A—184682/3/XAB) Infiltration kinetics of aluminum in silicon carbide compacts. Annual report.** Edwards, G.R.; Olson, D.L. (Colorado School of Mines, Golden (USA). Center for Welding Research). Jul 1987. 44p. (MT-CWR—087-032). NTIS, PC A03/MF A01.

Although metal-matrix composites have been fabricated by various techniques, the most successful are solid state processes such as powder metallurgy and diffusion bonding. Liquid-metal processes such as compucasting, pultrusion, and infiltration, while less successful, are potentially more economical. The advantages of producing silicon carbide-aluminum matrix composites by liquid-metal infiltration techniques can not be fully realized without an improved understanding of the infiltration behavior and the fiber/matrix bonding mechanisms. This paper reports on infiltration models which consider the physical properties of the liquid and preform (either porous compact or capillary/tube bundle). These properties include viscosity, density, surface tension, and wettability (pore shape and size in the case of the porous compact). The models have been assessed in terms of their ability to predict infiltration behavior from known physical properties of the materials.

**7634 (DOE/ER/13436—T1) The generalized van der Waals theory of pure fluids and mixtures: Annual report for the period December 1986 to November 1987.** Sandler, S.I. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1987. Contract FG02-85ER13436. 8p. NTIS, PC A02. Order Number DE88002380/JAW.

The objective of the work is to use the generalized van der Waals theory as derived earlier to: (1) understand the molecular level assumptions inherent in current thermodynamic models; (2) use theory and computer simulation studies to test these assumptions; and (3) develop new, improved thermodynamic models based on better molecular level assumptions. From this fundamental study, thermodynamic models are being developed that will be applicable to mixtures of molecules of widely different size and functionality, as occurs in the processing of heavy oils, coal liquids and other synthetic fuels, and in biological separations. An important aspect of the work is to reduce our fundamental theoretical developments to engineering practice through extensive testing and evaluation with experimental data on real mixtures.

**7635 (N—87-29356) Theoretical and material studies on thin-film electroluminescent devices. Biannual report no. 4, 1 October 1986-31 March 1987.** Summers, C.J.; Benz, R. II. (Georgia Inst. of Tech., Atlanta (USA). Research Inst.). Jun 1987. 17p. (NASA-CR—181347; NAS—1.26:181347). NTIS, PC A02/MF A01.

The effect of surface nucleation processes on the quality of ZnS layers grown on (001) GaAs substrates by molecular beam epitaxy is reported. Reflection high energy electron diffraction indicated that nucleation at high temperatures produced more planar surfaces than nucleation at low temperatures, but the crystalline quality as accessed by x ray double crystal diffractometry is relatively independent of nucleation temperature. A critical factor in layer quality was the initial roughness of the GaAs surfaces.

**7636 (PB—87-230686/XAB) Program description of FIBRAM: a radiation attenuation model for optical fibers.** Ingram, W.J. (Department of Commerce, Boulder, CO (USA). Inst. for Telecommunication Sciences). Jun 1987. 117p. (NTIA—87-216). NTIS, PC A06/MF A01.

For system on diskette, see PB—87-230678.

The report describes a fiber optics system model and its computer implementation. This implementation can calculate the bit error ratio (BER) versus time for optical fibers that have been exposed to gamma radiation. The program is designed so that the user may arbitrarily change any or all of the system input variables and produce separate output calculations. The primary output of the program is a table of the BER as a function of time. This table may be stored on magnetic media and later incorporated into computer graphics programs.

**7637 (SAND—87-2694C) Processing and interfacial analysis of glass-ceramic to metal seals.** Lochman, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-871207—20). NTIS, PC A02. Order Number DE88002999/JAW.

From Symposium on technology of glass, ceramic, or glass-ceramic to metal sealing; Boston, MA, USA (13 Dec 1987).

Glass-ceramics are useful for metal-insulator seals because of their ease of processing and the wide range of thermal expansion coefficients (CTE's) that can be obtained. Using glass-ceramics to full advantage requires detailed understanding of crystallization mechanisms and of possible interfacial reactions between the metal and the glass-ceramic. Such an understanding has been obtained for one family of $Li_2O$-$SiO_2$ glass-ceramics that have been sealed to a wide variety of high CTE alloys. Sealing reactions that promote interfacial bonding may create reaction zones with different CTE's. The properties of those reaction zones can be measured so they can be taken into account when designing glass-ceramic to metal seals. 14 refs., 5 figs., 1 tab.

**7638 (UCID—21187) Diamond turning of silicon for optics applications.** Taylor, J.S.; Syn, C.K.; Donaldson, R.R.; Patterson, S.R. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002501/JAW.

The goal of this study is to examine the feasibility of fabricating silicon optical surfaces by diamond turning. Our approach has been to machine small slices of single crystal silicon using a range of process parameters similar to what has typically been employed with ductile materials. In this manner, a set of conditions has been bracketed which has yielded good values of surface finish as measured by stylus profilometry, and low levels of surface damage as indicated by scanning electron microscopy. The surfaces generated thus far have also yielded information of a fundamental nature which relates to the turning of brittle materials in general. Recommendations for further work are suggested to maximize the material removal rate without compromising surface quality, to quantify any tendency to generate figure errors, and determine what problems are involved in scaling the process to larger surfaces.

**7639 (UCRL—15959) Pin joints, gears, springs, cranks, and other novel micromechanical structures.** Fan, Long-Sheng; Tai, Yu-Chong; Muller, R.S. (California Univ., Berkeley (USA)). Aug 1987. Contract W-7405-ENG-48. 5p. NTIS, PC A02. Order Number DE88002504/JAW.

We report here the first fabrication of micrometer-scaled pin joints, gears, springs, cranks, and sliders made with silicon planar technology. These micromechanical structures are batch-fabricated in an IC-compatible process using polysilicon deposited by chemical vapor deposition from silane and the sacrificial-layer technique first described by Howe and Muller. An important feature of this new technology makes use of the high surface mobility of polysilicon during CVD growth to refill undercut regions in order to form restraining flanges. The movable mechanical elements are built on layers that are later removed to free them so that translation and rotation can take place. Although this initial demonstration of the technique for making these structures has employed polysilicon as the structural material and phosphosilicate glass (PSG) for the sacrificial layer, other materials compatible with the IC process can be substituted as appropriate.

**7640 (UCRL—50025-87-2, pp 28-36) Microstructures.** Ciarlo, D.; Miller, D. Sep 1987. NTIS, PC A04/MF A01. Order Number DE88001586/JAW.

In Electronics Engineering Department: EE technical review.

This report discusses the design and fabrication of physical, nonelectronic microcomponents for use as targets and diagnostic devices. These components, called microstructures, perform optical or mechanical functions; their dimensions are frequently measured in micrometers, and their dimensional tolerances are measured in submicrometers. The procedures used to fabricate such miniature devices are similar to those used to fabricate integrated circuits (ICs); indeed, IC fabrication techniques have been borrowed to build microstructures in the micrometer and submicrometer range. Recently, three objectives were fulfilled that enhanced the ability to supply microstructures to Laboratory programs. Specifically: honed procedures for fabricating thin boron nitride windows; improved ability to etch thick polyimide layers in an oxygen plasma; and studied the anisotropic etching of silicon. In these studies we concentrated on fabricating blazed diffraction gratings and on bending silicon wafers chemically. The latter technique involves etching grooves in the wafers and then filling them with silicon dioxide grown in a high-temperature steam environment.

**7641 Boron hydride polymer coated substrates.** Pearson, R.K.; Bystoff, R.I.; Miller, D.E. (to Dept. of Energy, Washington, DC). US Patent 4,701,379. 20 Oct 1987. Filed date 27 Aug 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described of coating a substrate with a uniformly smooth layer of boron hydride polymer, comprising: (a) providing an apparatus for generating a boron hydride plasma. The apparatus has a wall means defining a sealable plasma chamber, inlet and outlet means operatively connected to the chamber, and means for generating a plasma discharge within the chamber; (b) disposing a substrate within the chamber; (c) evacuating the chamber through the outlet means; (d) introducing a boron hydride feedstock into the chamber through the inlet means; and (e) generating a plasma discharge within the chamber simultaneously with the introduction of the hydride feedstock into the chamber and continuing the discharge therein to form a boron hydride plasma of ions, electrons and free radicals which interact to form on the substrate a layer of boron hydride polymer with a uniformly smooth surface.

**7642 Radiation damage in silicate glass.** DeNatale, J.F.; Howitt, D.G.; Arnold, G.W. (California Univ., Davis, USA. Dept. of Mechanical Engineering; Sandia National Labs., Albuquerque, NM, USA). *Radiation Effects*; 98: No. 1-4, 63-70(Sep 1986). (CONF-8507164—).

From 3. international conference on radiation effects in insulators; Guildford, UK (15 Jul 1985).

The response of silicate glass to heavy ion irradiation is consistent with observations of bubble formation from electron irradiation. The development of internal stress in ion-irradiated borosili-

cate glasses correlates with the energy deposition into electronic processes. Displacement events have negligible influence on the formation of microstructural defects. For nuclear waste disposal, glass radiolysis processes are the more important to consider. (U.K.).

# 40 CHEMISTRY

## 4001 Analytical And Separations Chemistry

*REFER ALSO TO CITATION(S) 7541, 7863*

**7643 (EUR—10752) Identification of inclusions and surface states in cold rolled sheet by photoacoustic spectrometry: Final report.** De Gregorio, P. (Centro Sperimentale Metallurgico, Rome (Italy)). 1986. 53p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900130/JAW.

In the panorama of physical and chemical analysis techniques for characterizing structural materials such as cold-rolled sheet, photoacoustic spectrometry (PAS) has been making headway in recent times. The photoacoustic effect consists in generation of a signal (acoustic or piezoelectric) by a sample enclosed in a cell exposed to intermittent monochromatic radiation at acoustic frequencies. Part of the energy absorbed is re-emitted as heat and measured via the pressure variations induced in the gas in contact with the surface of the sample. The absorption spectra (PAS) characteristic of every individual compound are plotted as a function of incident radiation wavelength. The signals relative to the chemical and/or physical characteristics of the surface or the internal layers of the sample are plotted as a function of signal delay or intensity. The only spectrometer available on the market was used to assess the possibility of employing the system for quality control of iron and steel products. This is a low-cost instrument with very limited spectral/characteristics (spectral range and intermittency frequency). Particular difficulties were encountered due to the lack of robustness of the instrument for continuous use. This resulted in long interruptions on the work in order to make checks and carry out repairs. 6 refs., 16 figs.

**7644 (IAEA-RL—149) Intercomparison of radionuclide measurements in marine fish flesh sample MA-B-3. Intercomparison run MA-B-3/1: Man-made radionuclides. Intercomparison run MA-B-3/2: Natural radionuclides. Final report no. 32.** (International Atomic Energy Agency, Monaco-Ville (Monaco). Lab. of Marine Radioactivity). Aug 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700799/JAW.

This final report presents results of the laboratory intercomparison of the activity concentration determination of /sup 40/K, /sup 90/Sr, /sup 137/Cs, /sup 210/Pb, /sup 210/Po, /sup 226/Ra, /sup 228/Th, /sup 230/Th, /sup 232/Th, /sup 238/U, /sup 239/Pu, /sup 240/Pu and /sup 241/Am in the sample of garpike fish organized by the IAEA's Analytical Quality Control Service. The forty-three laboratories from twenty-three countries have reported results established by different analytical techniques. This sample is intended as a reference material for the measurement of /sup 40/K and /sup 137/Cs in marine biological samples and other similar matrices. 4 refs, 9 tabs.

**7645 (INFN/BE—84-8) Mass spectrometry by means of tandem accelerators. Present status and perspectives.** Tuniz, C. (Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 1985. 59p. (In Italian). (CONF-8410484—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700768/JAW.

From Congress of the Italian Physical Society; Genoa, Italy (4 Oct 1984).

Mass spectrometry based on an accelerator allows to measure rare cosmogenic isotopes found in natural samples with isotopic abundances up to 10E-15. The XTU Tandem of Legnaro National Laboratories can measure mean heavy isotopes (36Cl, 41Ca, 129I) in applications in cosmochronology and Medicine. The TTT-3 Tandem of the Naples University has been modified in view of precision studies of C14 in Archeology, Paleantology and Geology. In this paper a review is made of principles and methodologies and of some applicationy in the framework of the National Program for mass spectrametry research with the aid of accelerators. 31 refs.

**7646 (N—87-28955) Atlas of absorption lines from 0 to 17900 cm (sup)-1.** Park, J.H.; Rothman, L.S.; Rinsland, C.P.; Pickett, H.M.; Richardson, D.J.; Namkung, J.S. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1987. 197p. (NASA-RP—1188; L—16330; NAS—1.61:1188). NTIS, PC A09/MF A01.

Plots of logarithm (base 10) of absorption line strength versus wavenumber from 0 to 17900/cm(sup)-1 are shown for the 28 atmospheric gases ($H_2O$, $CO_2$, $O_3$, $N_2O$, CO, $CH_4$, $O_2$, NO, $SO_2$, $NO_2$, $NH_3$, $HNO_3$, OH, HF, HCl, HBr, HI, ClO, OCS, $H_2CO$, HOCl, $N_2$, HCN, $CH_3Cl$, $H_2O_2$, $C_2H_2$, $C_2H_6$, $PH_3$), which appear in the 1986 Air Force Geophysics Laboratory high-resolution transmission molecular absorption data base (HITRAN) compilation, and for O(P-3), O-18 isotopic ozone, and HO2 from the 1984 JPL compilation in the 0- to 200/cm(sup)-1 region, and infrared solar CO lines at 4500 K. Also shown are plots of logarithm (base 10) of approximate infrared absorption cross sections of 11 heavy molecules versus wavenumber. The cross-section data cover 700 to 1800/cm(sup)-1 and are included as a separate data file in the 1986 HITRAN database.

## 4002 Inorganic, Organic And Physical Chemistry

*REFER ALSO TO CITATION(S) 7132, 7133, 7134, 7217, 7237, 7316, 7441, 7632, 7634, 7847, 7848, 7873, 7882*

**7647 (DOE/ER/13154—12) Experimental and theoretical study of condensation in multicomponent mixtures: Quarterly report No. 12, 15 November 1986-14 February 1987.** Waterhouse, R.; Frish, M.B.; Wilemski, G. (Physical Sciences, Inc., Andover, MA (USA)). Sep 1987. Contract AC02-84ER13154. 13p. (PSI—154/TR-721). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002715/JAW.

This report covers the work performed during the twelfth quarter of a multilayer program to study the condensation of multicomponent vapors in a supersonic nozzle. New data for the binary system of 1-propanol and water are presented, discussed, and compared with theoretically predicted behavior.

**7648 (DOE/ER/13623—1) Experimental and theoretical studies of dense fluid mixtures: Scientific and technical progress report.** (Cornell Univ., Ithaca, NY (USA)). Nov 1987. Contract FG02-86ER13623. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002710/JAW.

A summary is given of work on the measurement of the thermodynamic properties, equations of state, and sound velocity of $CCl_4$, n-pentane, neopentane, $CCl_3F$, etc. No numerical data are given. (DLC)

**7649 (DOE/ER/13648—1) Theoretical studies of multicomponent mixtures: Phase equilibrium and transport: Progress report.** Kincaid, J.M. (State Univ. of New York, Stony Brook (USA). Dept. of Mechanical Engineering). 6 Nov 1987. Contract FG02-87ER13648. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002717/JAW.

This report begins, in Section A, by briefly noting the completion of three projects that began under previous DOE support. Section B describes a powerful technique developed for performing phase equilibrium calculations (both flash and dew/bubble). Finally, a new method for predicting the shear viscosity of simple mixtures is described in Section C.

**7650 (DOE/ER/13663—T1) Structure and reactivity of chemisorbed species and reaction intermediates: Progress report, February 1, 1987-November 30, 1987.** Madey, T.E. (National Bureau of Standards, Washington, DC (USA). Surface Science Div.). 1 Aug 1987. Contract AI01-87ER13663. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002161/JAW.

The areas of work have a common theme: the structure and reactivity of chemisorbed species and reaction intermediates of importance to catalysis. The results are presented in detail in Sections I and II: Surface Reactions and Catalysis Over Well-Characterized Surfaces, and Structure and Reactivity of Chemisorbed Species.

**7651 (DOE/ER/25026—15) Condensed chemical kinetic equations.** Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1987. Contract FG02-87ER25026. 9p. (UIUCDCS-R—87-1383; UILU-ENG—87-1772). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002597/JAW.

A different set of basic variables is proposed for modelling chemical kinetic equations. The order of the differential system is reduced to the number of reactions, the sparsity of the Jacobian of the differential system is normally reduced, and all mass invariants are automatically satisfied in this representation.

**7652 (N—87-29630) Theoretical research program to study transition metal trimers and embedded clusters. Final technical report, 1 July 1984-30 June 1987.** Walch, S.P. (Eloret Corp., Sunnyvale, CA (USA)). Oct 1987. 16p. (NASA-CR—181379; NAS—1.26:181379). NTIS, PC A02/MF A01.

The results of ab-initio calculations are reported for (1) small transition metal clusters and (2) potential energy surfaces for chemical reactions important in hydrogen combustion and high temperature air chemistry.

**7653 (N—87-29631) Nd bonding in the transition metal trimers: comparison of Sc3 and Y3.** Walch, S.P. (Eloret Corp., Sunnyvale, CA (USA)). 1987. 21p. (NASA-CR—181378; NAS—1.26:181378). NTIS, PC A02/MF A01.

CASSCF/CCI calculations are presented for the low-lying states of Y3. Comparison of the wave functions for Y3 and Sc3 indicates substantial 4d-5p hybridization in Y3, but little 3d-4p hybridization in Sc3. The increased 4d-5p hybridization leads to stabilization of 4dpi bonding with respect to 4dsigma bonding for equilateral triangle Y3, and also leads to 4d-5p bonding for linear geometries. These effects lead to a different ordering of states for equilateral triangle geometries and a smaller excitation energy to the linear configuration for Y3 as compared to Sc3.

**7654 (PB—88-112495/XAB) Reduction of $CO_2$. Annual report, July 1985-December 1986. Final report.** Sullivan, B.P.; Meyer, T.J. (North Carolina Univ., Chapel Hill (USA)). Mar 1987. 81p. NTIS, PC A05/MF A01.

See also report dated Jul 85, PB—86-136488.

The report reviews recent work on the development of electrocatalysts for $CO_2$ reduction. Comparison of the authors electrocatalysts based on polypyridine complexes of the second and third row transition metals is made with previous work, and both areas are set in the framework of the known chemistry and electrochemistry of both uncoordinated $CO_2$ and $CO_2$-transition metals complexes. The emphasis of the authors work has been on mechanistic questions. For example, the family of complexes fac-(ReI(bpy)(CO)3L)$n^+$ (where bpy is 2,2'-bipyridine and L is Br, Cl or $CH_3CN$) are facile stoichiometric or catalytic reagents that reduce $CO_2$ to CO, formate, or oxalate depending on the external conditions. Synthesis, electrochemical, and kinetic studies implicate the involvement of a minimum of five different pathways for the unusual system. A newly discovered electrocatalyt is the reactive metal hydride, $(Os(bpy)_2(CO)H)$ that has been found to reduce $CO_2$ by an associative mechanism yielding either CO or formate from a common intermediate. Related kinetic studies of fundamental steps in $CO_2$ activation or reduction have been conducted and their relationship to electrocatalytic $CO_2$ reduction has been highlighted. Examples include $CO_2$ insertion into a metal-alkoxide or metal-hydride bond. Finally, chemically modified electrodes have been prepared that allow the transposition of solution electrocatalytic chemistry to electrode surfaces.

**7655 Resonance Raman spectra of p-benzosemiquinone radical and hydroquinone radical cation.** Tripathi, G.N.R.; Schuler, R.H. (Univ. of Notre Dame, IN). *Journal of Physical Chemistry;* **91**: No. 23, 5881-5885(5 Nov 1987).

The time-resolved resonance Raman spectrum of the p-benzosemiquinone radical ($HOC_6H_4O$), excited at 415 nm and observed on the microsecond time scale in the pulse radiolysis of moderately acidic solutions of hydroquinone (pH 2-4), is reported. The nu/sub 7a/ CO stretching mode appears prominently in the spectrum at 1511 $cm^{-1}$, showing that the CO bond is very similar to that in phenoxyl where this vibration is observed at 1505 $cm^{-1}$. Strongly resonance enhanced bands are also observed at 1613 and 1162 $cm^{-1}$ and are assigned respectively to the nu/sub 8a/ ring stretching and nu/sub 9a/ CH bending modes. The strong enhancement of these latter vibrations, which are very much weaker in the corresponding spectrum of the phenoxyl radical, and the similarity of the ring stretching frequency (nu/sub 8a/) to that in p-benzosemiquinone radical anion (1620 $cm^{-1}$) indicate that there is a strong interaction of the OH p($\pi$) electron pair with the phenoxyl radical's $\pi$-electron system. The coefficient for the acid-catalyzed dehydroxylation of the OH adduct of hydroquinone is estimated from the pH and time dependences of the Raman signals of the semiquinone to be 5.4 x $10^8$ $M^{-1}$ $s^{-1}$. In strongly acidic solutions (e.g., ~ 2.3 M $H_2SO_4$) a second transient species, identified as the hydroquinone radical cation, is observed. The vibrational features of this radical are qualitatively similar to those for p-benzosemiquinone radical anion with the nu/sub 8a/ ring stretching mode very strongly resonance enhanced and observed at 1644 $cm^{-1}$. The nu/sub 7a/ CO stretching mode is observed at 1426 $cm^{-1}$ but is very much weaker than in the corresponding spectrum of the radical anion.

**7656 Percolation model of polydisperse composite solid propellant combustion.** Kerstein, A.R. (Sandia National Labs., Livermore, CA 94550). *Combustion and Flame;* **69**: No. 1, 95-112(Jul 1987).

The composition dependence of the burn rate of polydisperse composite solid propellants is predicted by analyzing the least-time path of the burn front through the propellant. The predicted burn rate is the average burn rate along the least-time path divided by the tortuosity, or arc length per streamwise interval, of the least-time path. The tortuosity analysis is based on percolation theory. Aspects of percolation theory which are pertinent to the analysis are introduced in a self-contained Appendix. The model, which contains four adjustable parameters, is validated by comparison to measured burn rates for a suite of polydisperse ammonium perchlorate composites. The data correlations are found to be significantly better than for a three-parameter version of the model which omits tortuosity considerations.

**7657 Application to mixtures of the Peng-Robinson equation of state with fluid-specific parameters.** Xu, Z.; Sandler, S.I. (Jiao Tong Univ., Sian). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1234-1238(Jun 1987).

The vapor-liquid equilibria and volumetric behavior of mixtures have been calculated by using the Peng-Robinson equation of state with fluid-specific temperature-dependent parameters proposed earlier. Illustrative calculations show that this modification of the Peng-Robinson equation of state results in a great improvement in the simultaneous correlation of phase compositions and phase densities and excellent predictions of molar volumes in the one-phase region.

**7658 Flow regime transitions in a bubble column with a paraffin wax as the liquid medium.** Bukur, D.B.; Petrovic, D.; Daly, J.G. (Dept. of Chemical Engineering, Texas A and M Univ., College Station, TX 77843). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1087-1091(Jun 1987).

Gas hold-up measurements were made in a 0.051-m-diameter by 3.05-m-long glass bubble column with a molten paraffin wax as the liquid medium. For temperatures between 230 and 280°C, there is a range of gas velocities where two modes of operation are possible, and they are referred to as the foamy and the turbulent bubbling flow regimes. The start-up velocity determines which flow regime are obtained. Transitions between these two flow regimes occur and are influenced by the temperature (i.e., the liquid viscosity) and the gas distributor design. Lower temperatures and/or perforated plate distributors with larger holes favor the existence of the turbulent bubbling flow regime.

7059 **Production rate improvement in plug-flow reactors with concentration forcing.** Thullie, J.; Chiao, L.; Rinker, R.G. (Institute of Chemical Engineering, Polish Academy of Science, Gliwice 44100). *Industrial and Engineering Chemistry Research;* 26: No. 5, 945-947(May 1987).

The authors compare the predictions of a dynamic reactor model which accounts for the transient behavior of the catalyst surface (model I) with a model using steady-state kinetics (model II). Both models are based on a two-step, adsorption-desorption reaction sequence with Eley-Rideal kinetics. Model I represents real-system behavior more closely under dynamic conditions, but model II is often used and is simpler to use. The differences in the resulting calculated behavior between the two models for forced periodic oscillations of feed composition (concentration forcing) in a fixed-bed reactor are significant.

7060 **The chemistry of isolated transition metal clusters.** Riley, S.J.; Parks, E.K.; Liu, K. (Chemistry Div., Argonne National Lab., Argonne, IL 60439). pp 120-124 of Laser applications in chemistry. Evans, D.K. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—). Contract W-31-109-ENG-38.

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

Clusters containing two to several hundred atoms are generated by pulsed laser vaporization of a metal target located in a flow tube reactor. A continuous flow of inert carrier gas entrains and cools the vaporized plume of metal, resulting in rapid cluster growth. Reactant gases are injected into the flow downstream of the target, at a point where cluster growth has finished. After reagent mixing and chemical reactions occur, the products exit the tube into a vacuuM, and are formed into a molecular beam by collimators located in successive stages of differential pumping. In the highest vacuum stage the reaction products are identified by pulsed laser ionization and time-of-flight mass spectrometry. The paper discusses the measurements of absolute reaction rate constants, hydrogen uptake experiments, laser-induced desorption of adsorbates from clusters, and cluster-catalyzed chemical reactions. Such work provides one with information about the dependence of reactivity on cluster size, the geometrical configuration of cluster binding sites, the thermodynamics of adsorbate bonding, and the mechanisms of chemical reactions on cluster surfaces. These studies are bringing one closer to a detailed understanding of the interactions of metal surfaces with atoms and simple molecules.

7061 **Laser photochemistry of gallium-containing compounds.** Baughcum, S.L.; Oldenborg, R.C. (Chemistry Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 90-98 of Laser applications in chemistry. Evans, D.K. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

The production of gas-phase gallium atoms in the photolysis of trimethylgallium has been investigated at 193 nm and at other laser wavelengths. Ground state (4 /sup 2/P/sup 0//sub 1/2/) and metastable (4 /sup 2/P/sup 0//sub 3/2/) gallium atoms are detected using laser-induced fluorescence techniques. Our results indicate that gallium atoms continue to be produced at long times after the laser pulse. The observed dependences on photolysis laser fluence, trimethylgallium pressure, and buffer gas pressure are consistent with a mechanism in which highly excited gallium methyl radicals undergo unimolecular decomposition to produce gallium atoms. Since this process is observed to happen on the time scale of hundreds of microseconds, these results have important implications for studies of metal deposition and direct laser writing by laser photolysis of organometallic compounds.

## 4004 Electrochemistry

*REFER ALSO TO CITATION(S) 7524, 7527*

7062 **(EUR—9701) Development of methods for measuring microbiological and corrosive activity of sulfate-reducing bacteria: Final report.** (Institut de Recherches Hydrologiques, 54 - Nancy (France)). 1985. 45p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900237/JAW.

Two groups of methods for studying microbiological and corrosive events have been followed in this study. They are based on the fact that metal corrosion, in particular of iron, is an electrochemical phenomena even if biological processes can intervene. The first group of methods consisted of classical measurements of the following parameters: (1) corrosion potential; (2) polarization resistance; (3) slope of the anodic and cathodic TAFEL lines; (4) velocity of the general corrosion; and (5) pitting index. The second group of methods is more original, and concerns the potential measurements in "biological electrical batteries." Such a battery consists of two half elements (electrodes immerged in an electrolyte) that are identical at the onset of the experiment except for the presence of sulfate-reducing bacteria in one cell whereas the other one is sterile. The influence of temperature and bacteric population on the corrosion activity has been studied. The temperatures varied between 25 and 45°C and the bacteric concentration between 0 and 20,000 bacteria/ml. Bacterial corrosion can already be detected a few days after the start of an experiment. This fast response indicates the potential of this method relative to classical microbiological methods. 29 figs.

7063 **(N—87-29914, pp vp) Electrochemical generation of useful chemical species from lunar materials.** Sammells, A.F.; Semkow, K.W. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

A high temperature electrolytic cell which simultaneously generates oxygen at the anode and liquid alkali metals at the cathode is electrochemically characterized. The electrolytic technology being investigated utilizes the oxygen vacancy conducting solid electrolyte, yttria stabilized zirconia, which effectively separates the oxygen evolving (at La0.89Sr0.10MnO3) and alkali metal (Li, Na) reducing (from a molten salt at either Pt or FeSi2) half cell reactions. In the finally engineered cell liquid alkali metal would be continuously removed from the cathode compartment and used as an effective reductant for the direct thermochemical refining of lunar ores to their metallic state with simultaneous oxidation of the alkali metal to its oxide. The alkali metal oxide would then be reintroduced into the electrolytic cell to complete the overall system cycle.

7064 **(N—87-29914, pp vp) Advanced hydrogen electrode for hydrogen-bromide battery.** Kosek, J.A.; Lasconi, A.B. Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Binary platinum alloys are being developed as hydrogen electrocatalysts for use in a hydrogen bromide battery system. These alloys were varied in terms of alloy component mole ratio and heat treatment temperature. Electrocatalyst evaluation, performed in the absence and presence of bromide ion, includes floating half cell polarization studies, electrochemical surface area measurements, x-ray diffraction analysis, scanning electron microscopy analysis and corrosion measurements. Results obtained to date indicate a platinum rich alloy has the best tolerance to bromide ion poisoning.

7665 (N—87-29914, pp vp) **Perovskite oxides: Oxygen electrocatalysis and bulk structure.** Carbonio, R.E.; Fierro, C.; Tryk, D.; Scherson, D.; Yeager, E. (Universidad Nacional de Cordoba, Argentina ). Sep 1987. NTIS, PC A16/MF A01. (NASA-CP—2484; E—3506; NAS—1.55:2484; CONF-8704101—).

From Space electrochemical research and technology conference; Cleveland, OH, USA (14 Apr 1987).

Perovskite type oxides were considered for use as oxygen reduction and generation electrocatalysts in alkaline electrolytes. Perovskite stability and electrocatalytic activity are studied along with possible relationships of the latter with the bulk solid state properties. A series of compounds of the type LaFe(x)Ni1(-x)O3 was used as a model system to gain information on the possible relationships between surface catalytic activity and bulk structure. Hydrogen peroxide decomposition rate constants were measured for these compounds. Ex situ Mossbauer effect spectroscopy (MES), and magnetic susceptibility measurements were used to study the solid state properties. X-ray photoelectron spectroscopy (XPS) was used to examine the surface. MES has indicated the presence of a paramagnetic to magnetically ordered phase transition for values of x between 0.4 and 0.5. A correlation was found between the values of the MES isomer shift and the catalytic activity for peroxide decomposition. Thus, the catalytic activity can be correlated to the d-electron density for the transition metal cations.

## 4005 Photochemistry

*REFER ALSO TO CITATION(S) 7661, 7666, 7847, 7848*

## 4006 Radiation Chemistry

*REFER ALSO TO CITATION(S) 7655*

7666 (DOE/ER/00038—3035) **University of Notre Dame Radiation Laboratory: Quarterly report, July 1-September 30, 1987.** (Notre Dame Univ., IN (USA). Radiation Lab.). 21 Oct 1987. Contract AC02-76ER00038. 38p. (NDRL—3035). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002266/JAW.

Abstracts are presented of 57 reports on various topics in radiation chemistry and photochemistry. (DLC)

## 4007 Radiochemistry And Nuclear Chemistry

*REFER ALSO TO CITATION(S) 7897, 7898, 7899*

7667 (AAEC/E—639) **Derivation of a specification for fission-produced molybdenum-99 for the preparation of AAEC (autoclaved) Mk IIB /sup 99/Mo//sup 99m/Tc generators.** Boyd, R.E.; Druce, M.J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700779/JAW.

Technetium-99m eluates are shown to contain significantly lower levels of radionuclidic impurities than the parent /sup 99/Mo feed solution. It is well established that alumina absorption of /sup 99/Mo followed by saline elution of /sup 99m/Tc leads to a considerable overall decontamination effect. This decontamination factor (DF) is defined as the ratio of radionuclidic impurities in the /sup 99/Mo feed solution to radionuclidic impurities in the eluted /sup 99m/Tc. Impurity measurements were made on samples of fission product /sup 99m/Mo feed solutions and /sup 99m/Tc eluates from nominal 20 GBq and 150 GBq AAEC (autoclaved) Mk IIB generators. Minimum DFs were obtained which were then used to derive radionuclidic purity criteria for /sup 99/Mo to satisfy the requirements of the British Pharmacopoeia.

## 4008 Combustion, Pyrolysis, And High-temperature Chemistry

*REFER ALSO TO CITATION(S) 7233, 7656*

7668 (N—87-28628) **Hydrogen oxidation mechanism with applications to (1) the chaperon efficiency of carbon dioxide and (2) vitiated air testing.** Brabbs, T.A.; Lezberg, E.A.; Bittker, D.A.; Robertson, T.F. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Sep 1987. 15p. (NASA-TM—100186; E—3672; NAS—1.15:100186). NTIS, PC A02/MF A01.

Ignition delay times for the hydrogen/oxygen/carbon dioxide/argon system were obtained behind reflected shock waves. A detailed kinetic mechanism modeled the experimental hydrogen/oxygen data, Skinner and Ringrose's high-pressure data, and Slack and Grillo's hydrogen/air data. A carbon dioxide chaperon efficiency of 7.0 +/- 0.2 was determined. The reaction pathway $H_2O$ yields $H_2O_2$ yields OH yields H was required to model the high-pressure data. It is suggested that some of the lowest temperature data points (1.0 and 0.5 atm) for Slack and Grillo's hydrogen/air experiments are in error. It was found that the technique of simplifying a detailed kinetic mechanism for a limited range of experimental data may render the model useless for other test conditions.

7669 (N—87-28634) **Temperature dependence of inelastic light scattering from small particles for use in combustion diagnostic instrumentation. Final report, 1 October 1982-30 September 1986.** Cloud, S.D. (Nevada Univ., Las Vegas (USA)). Oct 1987. 27p. (NASA-CR—180399; NAS—1.26:180399). NTIS, PC A03/MF A01.

A computer calculation of the expected angular distribution of coherent anti-Stokes Raman scattering (CARS) from micrometer size polystyrene spheres based on a Mie-type model, and a pilot experiment to test the feasibility of measuring CARS angular distributions from micrometer size polystyrene spheres by simply suspending them in water are discussed. The computer calculations predict a very interesting structure in the angular distributions that depends strongly on the size and relative refractive index of the spheres.

7670 (N—87-29432, pp vp) **Holographic interferometry at Wright Aeronautical Laboratories.** Roquemore, M. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

The optical diagnostics requirements and plans for the Aero Propulsion Lab. are described. This laboratory is performing work in combustion as related to aero propulsion systems. They would like to use holography and other types of optical instrumentation for combustion diagnostics and flow visualization. A movie of a laser light sheet flow visualization of a combustor in operation was shown. This movie showed extremely clear examples of vortical and unsteady flow, and it would be of interest to use image analysis to quantify such data.

7671 (N—87-29432, pp vp) **Status of holographic interferometry at Wright Patterson Air Force Base.** Seibert, G. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

At Wright Patterson AFB, holographic interferometry has been used for nearly 15 years in a variety of supersonic and hypersonic wind tunnels. Specifically, holographic interferometry was used to study boundary layers, shock boundary layer interaction, and general flow diagnostics. Although a considerable amount of quantitative work was done, the difficulty of reducing data severely restricted this. In the future, it is of interest to use holographic interferometry in conjunction with laser Doppler velocimetry to do more complete diagnostics. Also, there is an interest to do particle field diagnostics in the combustion research facility. Finally, there are efforts in nondestructive testing where automated fringe readout and analysis would be extremely helpful.

7672 (N—87-29432, pp vp) **Temperature and concentration measurements in combustion.** Kashiwagi, T. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

A high speed two wavelength holographic interferometer is being used to simultaneously measure temperature and concentration distributions for ignition and flame spread. Lines from a cw $CO_2$ laser were used and the holograms recorded on a movie at 500 frames per/sec, individual frames were digitized with a microdensitometer. The detection on the fringe center was a major problem.

7673 (N—87-29432, pp vp) **Particle data reduction in Japan.** Nakayama, M. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

The characterization of atomized particles generated by various atomizer and the mechanics of their evaporation and combustion processes were studied. The need existed for visualizing the internal structure of flames including evaporation and combustion processes as well as for a better way of understanding spray particle generation mechanisms and internal structures. A particle sizer based on Fraunhofer diffraction for detecting particle size and in-line Fraunhofer holograms for observation of local spray particles were used. A novel visualizing technique based on computer technology was developed and is discussed.

7674 (N—87-29432, pp vp) **Combustion/particle sizing experiments at the Naval Postgraduate School Combustion Research Laboratory.** Powers, J.; Netzer, D. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

Particle behavior in combustion processes is an active research area at NPS. Currently, four research efforts are being conducted: (1) There is a long standing need to better understand the soot production and combustion processes in gas turbine combustors, both from a concern for improved engine life and to minimize exhaust particulates. Soot emissions are strongly effected by fuel composition and additives; (2) A more recent need for particle sizing/behavior measurements is in the combustor of a solid fuel ramjet which uses a metallized fuel. High speed motion pictures are being used to study rather large burning particles; (3) In solid propellant rocket motors, metals are used to improve specific impulse and/or to provide damping for combustion pressure oscillations. Particle sizing experiments are being conducted using diode arrays to measure the light intensity as a function of scattering angle; (4) Once a good quality hologram is attained, a need exists for obtaining the particle distributions from hologram in a short period of time. A Quantimet 720 Image Analyzer is being used to reconstruct images.

7675 (N—87-29432, pp vp) **Particle sizing in rocket motor studies utilizing hologram image processing.** Netzer, D.; Powers, J. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

A technique of obtaining particle size information from holograms of combustion products is described. The holograms are obtained with a pulsed ruby laser through windows in a combustion chamber. The reconstruction is done with a krypton laser with the real image being viewed through a microscope. The particle size information is measured with a Quantimet 720 image processing system which can discriminate various features and perform measurements of the portions of interest in the image. Various problems that arise in the technique are discussed, especially those that are a consequence of the speckle due to the diffuse illumination used in the recording process.

7676 (N—87-29432, pp vp) **Image processing system to analyze droplet distributions in sprays.** Bertollini, G.P.; Oberdier, L.M.; Lee, Y.H. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

An image processing system was developed which automatically analyzes the size distributions in fuel spray video images. Images are generated by using pulsed laser light to freeze droplet motion in the spray sample volume under study. This coherent illumination source produces images which contain droplet diffraction patterns representing the droplets degree of focus. The analysis is performed by extracting feature data describing droplet diffraction patterns in the images. This allows the system to select droplets from image anomalies and measure only those droplets considered in focus. Unique features of the system are the totally automated analysis and droplet feature measurement from the grayscale image. The feature extraction and image restoration algorithms used in the system are described. Preliminary performance data is also given for two experiments. One experiment gives a comparison between a synthesized distribution measured manually and automatically. The second experiment compares a real spray distribution measured using current methods against the automatic system.

7677 **(N—87-29634) Development of computerized analysis for solid propellant combustion (ISAP-2). Semiannual report.** Chung, T.J.; Hallit, R. (Alabama Univ., Huntsville (USA)). Nov 1987. 78p. (NASA-CR—181399; NAS—1.26:181399). NTIS, PC A05/MF A01.

This report is an improvement of ISAP-1, SRB Vorticity-Acoustic Coupled Instability Analysis, September 1986. Included in this report are the automatic generation of all input data for grid configuration, boundary conditions for coupled acoustic and vortical field calculations, transformation of all dimensions to a parametric form, resulting in flexibility for the user to define the size of the problem (geometric configurations) with reduction in storage (15 to 65%) and computer run-time (50 to 75%). Additional research is required for the following areas: (1) turbulence effects; (2) nonlinear wave oscillations; and (3) chemistry upon combustion instability.

## 42 ENGINEERING

*REFER ALSO TO CITATION(S) 7557*

7678 **(PB—88-100177/XAB) Semiannual compilation of Project Briefs, August 1986-July 1987 (Power Information Center).** (CSR, Inc., Washington, DC (USA). Power Information Center). Aug 1987. 62p. NTIS, PC A04/MF A01.

The Semiannual Compilation of Project Briefs represents a listing of the projects maintained in the Power Info Center (PIC) automated data base from August 1986 to July 1987. The information is presented in two separate categories. Part I is a listing by field of interest of the IAPG project briefs that were active or completed during this time. The fields of interest are chemical, electrical, magnetohydrodynamics, mechanicl, nuclear, solar, and systems energy research. The listing is arranged alphabetically within each field of interest and gives the brief number, title of the project, project manager, directing agency codes, research facility, funding information, and current status.

7679 (UCRL—50025-87-2, pp 37-44) **A methodology for solving complex design problems.** Payne, A.N. Sep 1987. NTIS, PC A04/MF A01. Order Number DE88001586/JAW.

In Electronics Engineering Department: EE technical review.

An optimization-based methodology is described that is being developed to help analyze and design complex engineering systems. Experience in applying this methodology to the analysis of an existing system, the Hall-effect sensor system for the mechanical safing and arming device used in the W87 warhead, is discussed.

## 4202 Facilities And Equipment

*REFER ALSO TO CITATION(S) 7284, 7638, 7639, 7721, 8304, 8343*

**7680 (DOE/ER/13683—1) An automated flow calorimeter for heat capacity and enthalpy measurements at elevated temperatures and pressures: Progress report, March 1, 1987-February 29, 1988.** Yesavage, V.F. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). Oct 1987. Contract FG02-87ER13683. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002357/JAW.

The need for thermal property data at process conditions in the design of petrochemical and synfuel plants has been well documented. As such, the primary objective of this work is to construct an automated flow calorimeter to measure isobaric heat capacities and enthalpies of vaporization over the range 0 to 30MPa and 300 to 700K with an anticipated accuracy of 0.1%. The method of measurement is by the traditional electrical power input technique with a unique calorimeter design utilizing a concentric coil/radiation shield structure which minimizes heat loss errors and simplifies the replacement of plugged components. Flow generation is accomplished with a precision Ruska pump eliminating the need for on-line flow rate measurement. In addition, the proposed instrument will be fully automated minimizing the need for highly skilled operators which had previously been a severe limitation with this type of instrument. Significant progress has been made on the project this last year with the completion of construction of all major system hardware components and the associated automation electronics. Initial tests of the equipment are encouraging and no significant delays are foreseen in the completion of the apparatus. During the next year the automation and data acquisition software will be written and the completed unit will be tested with water. 7 figs.

**7681 (EUR—10686) Development multi-purpose automatic spraymarker system: Final report.** Groothuizen, J.C. (Koninklijke Nederlandse Hoogovens en Staalfabrieken, Ijmuiden). 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900222/JAW.

Compared to marking on hot rolled coils or heavy plates the new productions area, such as continuous casting, have established the need for a new approach of marking. The use of an industrial robot, as a re-programmable manipulator, increased the flexibility within this investigation. Different marking methods are tested at which only the marking head has been altered. The robot itself has proven to be a reliable equipment under severe conditions of a steel plant.

**7682 (FNAL-TM—1476) Cryogenic instrumentation of an SSC [superconducting super collider] magnet test stand.** McGuire, K.; Strait, J.; Kuchnir, M.; McInturff, A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Sep 1987. Contract AC02-76CH03000. 9p. (CONF-8706125—16). NTIS, PC A02. Order Number DE88002659/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

This paper describes the system used to acquire cryogenic data for the testing of SSC magnets at the Fermilab Magnet Test Facility. An array of pressure transducers, resistance thermometers, vapor pressure thermometers, and signal conditioning circuits are used. Readings with time resolution appropriate for quench recording are obtained with a waveform digitizer and steady-state measurements are obtained with higher accuracy using a digital voltmeter. The waveform digitizer is clocked at a 400 Hz sampling rate and these readings are stored in local ring buffers. The system is modular and can be expanded to add more channels. The software for the acquisition, control, logging, and display of cryogenic data consist of two programs which run as separate tasks. These programs (as well as a third program which acquires quench and magnetic data) communicate and pass data using shared global resources. The acquired data are available for analysis via a nationwide DECnet network.

**7683 (JAERI-M—87-125) New representation for kinematics of manipulator.** Sasaki, Shinobu. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 26p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751446/JAW.

In place of the homogeneous co-ordinates transformation method, a vector formulation was introduced to the analysis of manipulator linkage mechanism. After calculating the location and orientation of individual joints, a combined operation of both the orientation of the finger-tip and the inversion of rotation operators led to kinematic descriptions different from those derived in the ordinary way. In addition, among them, direction cosines represented by the sixth joint angle $\theta$/sub 6/ were found to completely correspond to the expression of several parameters defined previously in the course of derivation of an algebraic equation in solving the inverse kinematics, and thereby, implication of each parameter became clear. The present approach will help to derive a variety of relationships between links.

**7684 (UCID—21240) Modal analyses of the Kernville diagnostic canister.** Stavnheim, B.L. (Lawrence Livermore National Lab., CA (USA)). 5 Nov 1987. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003268/JAW.

Multiple modal analyses were recently performed on the Kernville diagnostic canister. Vibration data were recorded using TEAC 21-channel data recorder and subsequently analyzed at Livermore using a new computer code "PROCESS" resulting in a significant improvement over prior methods of dynamic testing. To better evaluate the quality of results obtained from a dynamic analysis a repeatability test was performed. Test results demonstrated the ability to reproduce resonance frequencies to within 0.4%. It likewise emphasized the difficulty of evaluating resonance damping coefficients for lightly damped structures in the presence of noise. 5 figs., 3 tabs.

**7685 (UCRL—50025-87-2) Electronics Engineering Department: EE technical review.** (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001586/JAW.

This document has been prepared to inform readers of the activities of the Electronics Engineering (EE) Department and to promote the exchange of ideas. The articles, by design, are brief summaries of EE work. Topics covered are: nuclear magnetic resonance imaging and spectroscopy; maneuverable reentry vehicle terminal engagement simulation; system design for a remote-access panel prototype; microstructures; and a methodology for solving complex design problems. These five reports have been cataloged separately. (FI)

**7686 (UCRL—50025-87-2, pp 1-8) Nuclear magnetic resonance imaging and spectroscopy.** Harben, P.E. Sep 1987. NTIS, PC A04/MF A01. Order Number DE88001586/JAW.

In Electronics Engineering Department: EE technical review.

Nuclear magnetic resonance (NMR) imaging is a technique used in medicine to image many internal regions of the human body. While little of this technology has been used in nonmedical disciplines, we are now developing NMR imaging techniques to characterize the properties of materials of particular interest to researchers in LLNL programs. To perform NMR imaging, we first had to modify a solids spectrometer built at Sandia National Laboratories. We also built two sample probes and added such features as quadrature phase detection and spin-echo formation to enhance the images. Several test samples containing mobile water, including small water flasks and peapod sections, were imaged with good results. We also imaged with some success water in such materials as welded tuff rock cores. However, water in these samples sometimes became bound to the material walls (thus rendering the water immobile), and so far we have been able to image only samples containing some mobile water. With additional research, however, we

anticipate that solids can be successfully imaged with NMR technology. The potential in nonmedical applications is enormous.

7687 (UCRL—50025-87-2, pp 9-19) **MaRV terminal engagement simulation.** Ng, L.C. Sep 1987. NTIS, PC A04/MF A01. Order Number DE88001586/JAW.

In Electronics Engineering Department: EE technical review.

Evaluations of terminal engagement strategies for maneuverable re-entry vehicles (MaRVs) pose significant problems for system analysts who must visualize the three-dimensional complex interactions of a MaRV's maneuvers and an interceptor's trajectory over a given battle space. This situation gets more unwieldy when engagement scenarios involve more than a single MaRV and a single interceptor. The problem of visualizing these complex terminal engagement scenarios was mitigated by developing the following simulation tools to aid the analysts: generic dynamic models of MaRVs, interceptors, and other key components that make up the scenarios and user-friendly graphics that allow users to observe MaRV/interceptor confrontations at high speed and in three dimensions. With these tools an analyst can now examine and evaluate, in a matter of minutes, a number of terminal strategic battles as they evolve.

7688 (UCRL—50025-87-2, pp 20-27) **System design for a remote-access panel prototype.** Pihlman, M.; Edmunds, D. Sep 1987. NTIS, PC A04/MF A01. Order Number DE88001586/JAW.

In Electronics Engineering Department: EE technical review.

The upcoming automation of the Lawrence Livermore National Laboratory (LLNL) security system under the aegis of the Safeguards and Security Enhancements-Phase 1 program (SSE-1) requires the development of an intelligent, user-friendly communications link between employees and SSE-1's computer. When in place, this remote-access panel (RAP) will be the primary interface between LLNL employees requesting entry through CAIN II booths and access to the SILAS (Secure Interactive Livermore Alarm Station) security systems. Working in conjunction with the main SSE-1 computers, the RAP will automatically read an employee's badge number for identification and a memorized personal identification number for verification, and, as needed, will receive and transmit biometric information from a fingerprint or retinal scan.

7689 (UCRL—95585) **Ion beam self-supporting using a cathodic arc ion source.** Sanders, D.M. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 19p. (CONF-871125—13). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002466/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

A low voltage/high current vacuum arc offers a means of producing high current ion beams. These beams can be employed in conjunction with suitable anode and sputter target configurations to permit coating production by self-sputtering without the necessity for adding process gas. This paper describes the influence of sputtering angle and target voltage on coating rate and morphology.

7690 (UCRL—97183) **Faraday cup characterization of electron beam welding parameters.** Burgardt, P.; Knaus, S.E.; Kautz, D.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Lawrence Livermore National Lab., CA (USA)). 12 Oct 1987. Contract AC04-76DP03533. 16p. (CONF-8709178—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001896/JAW.

From International conference on applications of electron and laser beam welding; Hartford, CT, USA (16 Sep 1987).

The use of the electron beam welding process to produce precision welds on many materials has been well documented in the literature. Some joint configurations may need more parameter control than is typically afforded by the standard electron beam welding machine. The repeatability and transferability of the electron beam welding parameters must also be regarded during weld development on many designs. Types of instrumentation which enhance the parameter control should be developed to higher levels. This instrumentation is important to the accurate transfer of technology between welding machines and production cycles. 7 refs., 6 figs., 1 tab.

7691 **Cryogenic support member.** Niemann, R.C.; Gonczy, J.D.; Nicol, T.H. (to Dept. of Energy, Washington, DC). US Patent 4,696,169. 29 Sep 1987. Filed date 15 May 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A cryogenic support member is described for restraining a cryogenic system comprising; a rod having a depression at a first end. The rod is made of non-metallic material. The non-metallic material has an effectively low thermal conductivity; a metallic plug; and a metallic sleeve. The plug and the sleeve are shrink-fitted to the depression in the rod and assembled thereto such that the plug is disposed inside the depression of the rod. The sleeve is disposed over the depression in the rod and the rod is clamped therebetween. The shrink-fit clamping the rod is generated between the metallic plug and the metallic sleeve.

7692 **Experience with cooldown of superconducting magnet coils in the large coil task.** Haubenreich, P.N.; Fietz, W.A.; Ellis, J.F.; Lue, J.W.; Mc Manamy, T.J.; Schwenterly, S.W.; Stamps, R.E.; Kato, T.; Koizumi, K.; Kamiya, S. (Oak Ridge National Lab., P.O. Box Y, Building 9204-1, MS-14, Oak Ridge, TN 37831). pp 1803-1810 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Six superconducting toroidal field coils have been tested in the Large Coil Task. In three coils, conductors are bath cooled. Three have conductors cooled by internal flow of helium. Coils provided by JAERI and EURATOM were cooled first in single-coil facilities at Naka and Karlsruhe. In the International Fusion Superconducting Magnet Test Facility (IFSMTF) at Oak Ridge, the 420,000-kg, six-coil array was successfully cooled to operating temperature early in 1986. Analysis of the IFSMTF data and comparison with cooldown of magnets in other facilities provided better understanding of massive, multicomponent arrays.

7693 **Oak Ridge develops an advanced servomanipulator.** Feldman, M.J. (Oak Ridge National Lab., TN, USA). *Nuclear Engineering International;* **31**: No. 381, 44-45(Apr 1986).

The Oak Ridge National Laboratory has developed an advanced force-reflecting servomanipulator, employing a highly sophisticated digital control system. The development of the manipulator is briefly outlined. A description of the advanced servomanipulator is given and the current status indicated. (U.K.).

7694 **A proposal for a 0.5 K, atmospheric pressure liquid helium cooling system for a polarized proton target.** Warren, R.P.; Schuler, K.P.; Hughes, V.W. (Yale Univ., New Haven, CT). pp 180-181 of The 75th jubilee conference on helium-4. Armitage, J.G.M. Teaneck, NJ; World Scientific Pub. Co. (1983). (CONF-8308233—).

From 75. jubilee conference on helium - 4; St. Andrews, UK (1 Aug 1983).

The great heat removal capability of pressurized superfluid helium has led in recent years to its use as a coolant in fusion and accelerator magnets where the operating temperature is 2 K. The low temperature liquid region is pressurized via a liquid filled channel which communicates with a saturated liquid near one atmosphere pressure and 4.2 K. A recent proposal extends this technique down to 0.5 K for the cooling of a polarized proton/deuteron target. This experiment involves the scattering of longitudinally polarized electrons off polarized protons in an irradiated ammonia target and polarized deuterons in a deuterated ammonia target. The intense heating of the target by the electron beam and polarizing microwave radiation of the 20 cm/sup 3/ porous target necessitates a departure from the relatively mature technology of direct cooling by pool or forced convection boiling.

## 4203 Lasers

**7695 (AD-A—184634/4/XAB) Low-energy pumping of a 108.9-nm xenon Auger laser.** Yin, G.Y.; Barty, C.P.; King, D.A.; Walker, D.J.; Harris, S.E. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). May 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 5, 331-333(May 1987).

Extensive measurements of gain in the Xe III system initially observed by Kapteyn et al. are reported here. The dependence of this gain on pressure, pumping-pulse length, and pump energy is presented. By optimizing these parameters, a gain of exp(3.2) was achieved by using only 0.56 J of 1064-nm energy on target, representing an efficiency improvement of nearly 100. Total gains as high as exp (6.6) were measured when using higher energies. Data here indicate that effective laser-produced plasmas can be created with applied power densities as low as $5 \times 10^{10}$ W/sq cm.

**7696 (AD-A—184652/6/XAB) Injection behavior of high-power broad-area diode lasers.** Abbas, G.L.; Yang, S.; Chan, V.W.; Fujimoto, J.G. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Aug 1987. 4p. (JA—5963). NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, 605-607(Aug 1987).

A single-mode diode laser is injected into a high-power broad-area diode laser to produce single-mode operation of 80 mW. Spectrally resolved near- and far-field measurements suggest a simple Fabry-Perot amplifier model that qualitatively explains the observed injection and beam-steering behavior in these devices as well as gain-guided multiple-stripe arrays. This model provides criteria for the optimization of injection performance.

**7697 (BLEV-R—65.829-1) Laser communication links. Final report.** Endemann, M.; Reiland, W. (Battelle-Institut e.V., Frankfurt am Main (Germany, F.R.)). Apr 1986. 208p. (ESA-CR(P)—2374; ETN—87-90476). NTIS, PC A10/MF A01.

Program management and control, technical program coordination, and work on the local oscillator laser hardware development within ESA's $CO_2$ laser communication technology program are described. The local oscillator design and its tunability were reassessed and validated by experiments. The most promising solution was selected and realized by the fabrication of a first engineering model. The performance evaluation shows operation of the waveguide laser in the fundamental transverse mode with an output power greater than 100 mW across the full tuning range of 1400 MHz.

**7698 (UCRL—95285) Development of composite polymer-glass edge claddings for Nova laser disks.** Campbell, J.H.; Edwards, G.; Frick, F.A.; Gemmell, D.S.; Gim, B.M.; Jancaitis, K.S.; Jessop, E.S.; Kong, M.K.; Lyon, R.E.; Murray, J.E. (Lawrence Livermore National Lab., CA (USA)). 9 Oct 1987. Contract W-7405-ENG-48. 24p. (CONF-8710165—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002389/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

Large Nd:glass laser disks for disk amplifiers require an edge cladding which absorbs at 1 μm. This cladding prevents edge reflections from causing parasitic oscillations that would otherwise deplete the gain. We have developed a composite polymer-glass edge cladding that consists of absorbing glass strips bonded to the edges of laser glass disks using an epoxy adhesive. The edge cladding must survive a fluence of approximately 20 J/cm² in a 0.5-ns pulse. Failure can occur either by decomposition of the polymer or by mechanical failure from thermal stresses which leads to bond delamination. An epoxy has been developed that gives the required damage resistance, refractive index match and processing characteristics. A slight tilt of the disk edges greatly reduces the threat from parasitic oscillations and a glass surface treatment is used to promote bond adhesion. Laser disks fabricated with this new cladding show identical gain performance to disks using conventional fused-glass cladding and have been tested for over 2000 shots (equivalent to about a 4-year lifetime on Nova) without degradation. 43 refs., 16 figs., 3 tabs.

**7699 (UCRL—96365) Lawrence Livermore National Laboratory Soft X-ray Laser Program: Progress report.** Trebes, J.; Brown, S.; Campbell, E.M.; Ceglio, N.; Eder, D.; Gaines, D.; Hawryluk, A.; Keane, C.; London, R.; MacGowan, B. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 14p. (CONF-8710204—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001888/JAW.

From Society of Photo-Optical Instrumentation Engineers meeting; San Diego, CA, USA (17 Oct 1987).

Significant progress toward the goal of producing high power, high coherence x-ray lasers has been made. Lasing at wavelengths as low as 66 A has been achieved in a nickel like laser scheme which is scalable to sub-44 A wavelengths. In addition, x-ray laser cavities, x-ray holography, and an applications beamline have been demonstrated. 15 refs., 3 figs.

**7700 Precision cutting and drilling with the Nd-YAG laser.** Lingenfelter, A.C.; Anglin, C.D.; Westrich, C.N.; Murchie, J.R. (Materials Fabrication Div., Mechanical Engineering Dept., Lawrence Livermore National Lab., Livermore, CA 94550). pp 55-63 of Lasers in motion for industrial applications. Belforte, D.A. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870132—).

From OE/LASE '87; Los Angeles, CA, USA (11 Jan 1987).

The capability of focusing large amounts of energy onto a very small area makes the laser a useful tool for cutting and drilling materials. With the aid of appropriate aperture, lens and careful selection of laser parameters, the authors have been successful in cutting slots 0.001 inches (0.025 millimeters) in width and drilling holes 0.00015 inches (0.0038 millimeters) in diameter. Examples of these applications are shown. Cutting and drilling of foil thicknesses (less than 0.010 inches thick) poses a special problem. Despite careful selection of operating parameters there is normally some small amount of dross adhering to the bottom surface of the foil. They have found that various surface coatings can be used to protect the foil from damage both during processing and cleanup. Several examples illustrate the surface quality of cuts achieved with coated foils.

**7701 Excimer lasers and optics. SPIE volume 710.** Luk, T.S. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). 156p. SPIE Society of Photo-Optical Instrumentation Engineers, 1022 19 St., P.O. Box 10, Bellingham, WA 98227.

This book discusses the following contents: RESEARCH AND DEVELOPMENT. High average power commercial excimer lasers. Inductively stabilized excimer lasers. Characteristics of an e-beam pumped KrF laser system. Large excimer lasers for fusion. High power picosecond KrF laser system. MATERIAL PROCESSING. Fundamental aspects of pulsed-laser irradiation of semiconductors. Advances in excimer laser lithography. Laser photochemical vapor deposition. Studies of excimer laser etching mechanism using laser-induced fluorescence measurements. Industrial applications of excimer lasers. Excimer laser processing of semiconductor devices: high efficiency solar cells. RESEARCH AND DEVELOPMENT II. Review of UV laser damage measurements at Lawrence Livermore National Laboratory. Generation of subnanosecond excimer laser pulses by means of stimulated Brillouin scattering in liquids. Amplification in a XeCl excimer gain module of 200-fsec UV pulses derived from a colliding pulse mode-locked (CPM) laser system. High order multiphoton processes observed with subpicosecond excimer lasers. VUV fluorescence and harmonic generation with intense picosecond 248 nm KrF radiation. Excited state excimer spectroscopy. Multi-kilojoule narrowband XeCl laser. Performance and properties of e-beam pumped XeF(C → A) lasers. Long-pulse e-beam pumped excimer laser.

7702 **Lawrence Livermore National Laboratory X-ray laser research: Recent results.** Mac Gowan, B.J.; Brown, S.; Campbell, E.M.; Eckart, M.; Hagelstein, P.; Keane, C.; London, R.; Matthews, D.; Nilson, D.; Phillips, T. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 808, Livermore, CA 94550). pp 36-42 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Since the successful demonstration of gain in neon-like selenium using an exploding foil amplifier the x-ray laser group at Lawrence Livermore National Laboratory has investigated further the exploding foil amplifiers concept for use in XUV lasers. Results are reported of the characteristics of selenium amplifiers up to 50 mm in length. Observation of at least 16 gain lengths for the 206 A line of selenium is reported. Output powers in excess of 1 MW have been measured in pulses of approximately 200 picoseconds. The effects of refraction on the performance of long amplifiers have been studied. The occurrence time of the x-ray laser output relative to the input heating pulse has been measured and found to be in disagreement with a recent model that suggests three-body recombination driven by rapid radiative cooling as the inversion process in the selenium plasma. An exploding foil amplifier has been used to demonstrate gain in an analogous scheme in neon-like molybdenum.

7703 **Measurements on a proposed short wavelength laser system in Xenon III.** Kapteyn, H.C.; Murnane, M.M.; Falcone, R.W.; Kolbe, G.; Lee, R.W. (Dept. of Physics, Univ. of California, Berkeley, CA 94720). pp 54-60 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Measurements on a proposed short wavelength laser system at 108.9 nm in doubly ionized Xenon are reported. Previous electron spectroscopy data indicate that a population inversion should be created between the Xe III states 5s/sup 0/5p/sup 6/ /sup 1/S/sub 0/ and 5s/sup 0/5p/sup 6/ /sup 1/P/sub 1/ due to selective Auger decay following photoionization of a 4d electron from the neutral atom. Using a high repetition rate laser produced plasma x-ray source and time correlated photon counting, they measured the lifetime of the /sup 1/S/sub 0/ upper state to be 4.75 +- 0.15 nsec with a collisional quenching rate of 2.8+-0.2x10/sup 7/ (torr-sec)/sup -1/. The authors also determined the Auger branching ratio into the upper and lower states by measuring the fluorescence intensities. Implementation of this laser scheme is discussed including limitations in photopumping short wavelength lasers due to amplified spontaneous emission.

7704 **Photoionization-pumping of sodium vapor with the Lawrence Livermore National Laboratory soft-X-ray laser.** Wood, O.R. II; Silfvast, W.T.; Trebes, J.E.; Matthews, D.L.; Mac Gowan, B.J. (AT and T Bell Labs., Holmdel, NJ 07733). pp 50-53 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The authors propose to construct an inner-shell photoionization laser in sodium at 37.2 nm by photoionizing sodium vapor with the 20.6 and 20.9 nm outputs from the Lawrence Livermore National Laboratory (LLNL) soft-x-ray laser. Pumping a 10 cm long cell filled with sodium vapor at 1 torr with the 1 mJ, 175 psec duration, pulse from the LLNL Se laser should result in a gain-length product in excess of 16. This would lead to an intense pulse of amplified spontaneous emission at 37.2 nm.

7705 **Time and space resolved spectroscopy of x-ray laser experiments from 81A to 220A.** Ceglio, N.M.; Medecki, H. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-473, Livermore, CA 94550). pp 26-35 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Data are presented from three different x-ray laser inversion schemes tested on the Novette laser facility at LLNL: collisional excitation of neon-like selenium ($\lambda$ = 206, 209, 220A); resonant photoexcitation of hydrogen-like fluorine ($\lambda$ = 81A); and recombination of hydrogen-like magnesium ($\lambda$ = 130A). The data illustrate the measurement capabilities of a new, time resolved imaging spectrometer (TGSS-EM), and provide insight to the dynamics and emission characteristics of a new class of laser produced plasmas.

7706 **X-ray laser cavity experiments.** Ceglio, N.M.; Gaines, D.P.; Trebes, J.; Hawryluk, A.M.; Stearns, D.G.; Howe, G.L. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-473, Livermore, CA 94550). pp 44-49 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The authors report progress toward the development of multipass, soft x-ray laser cavities operating in a spectral range around 200 A. Experimental results on the characterization of normal incidence multilayer mirrors, the survival of multilayer mirrors in the hostile x-ray laser environment, and the performance of double pass cavities at 206 A to 209 A are presented.

7707 **Laboratory X-ray lasers: Future prospects and goals.** Matthews, D.L. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, Livermore, CA 94550). pp 67-74 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The author's present goal is to design, demonstrate and utilize a sub 44 A, single transverse mode number, saturated (GL $\geqq$ 16-20), 1 GW x-ray laser. In this talk he summarizes the progress to date, critiques the various successful amplification techniques and describes some new ones which may make it possible to achieve the goal.

7708 **Characterization of multilayer structures for soft X-ray laser research.** Kuhne, M.; Danzmann, K.; Muller, P.; Wende, B.; Ceglio, N.M.; Stearns, D.G.; Hawryluk, A.M. (Physikalisch-Technische Bundesanstalt, Institut Berlin Abbestr. 2-12, D-1000 Berlin 10). pp 76-80 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A reflectometer has been set up at the radiometric laboratory of PTB at the Berlin electron storage ring BESSY. Special attention has been paid to optimize the instrumentation for the characterization of multilayer structures suitable for laboratory soft x-ray laser research. The instrumentation is described and its performance demonstrated showing examples of optical component characterization.

7709 **Soft X-ray beamsplitters and highly dispersive multilayer mirrors for use as soft X-ray laser cavity components.** Hawryluk, A.M.; Ceglio, N.M.; Stearns, D.G.; Danzmann, K.; Kuhne, M.; Muller, P.; Wende, B. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, L-473, Livermore, CA 94550). pp 81-90 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The demonstration of amplified spontaneous emission at soft x-ray wavelengths has highlighted the need for normal incidence optics for soft x-rays. Specifically, x-ray laser cavity components will be needed to further advances in x-ray laser research. In this paper, the authors present the fabrication, characterization and analysis of two possible cavity components, an x-ray beamsplitter and a highly dispersive multilayer mirror. Each of these can be used as x-ray laser cavity output couplers.

7710 **TEM and X-ray analysis of multilayer mirrors and beamsplitters.** Stearns, D.G.; Ceglio, N.M.; Hawryluk, A.M.; Danzmann, K.; Kuhne, M.; Muller, P.; Wende, B.; Stearns, M.B.; Petford-Long, A.K.; Chang, C.H. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5508, Livermore, CA 94550). pp 91-98 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Recent advances in the development of lasers at soft x-ray wavelengths has spurred increasing interest in the production of cavity components using multilayer technology. The authors have established a comprehensive capability to design, fabricate, and characterize multilayer x-ray optics directed towards the goal of building the first x-ray laser cavity.

7711 **Damage to multilayer mirrors in a hostile environment.** More, R.M.; Warren, K.H.; Zinamon, Z. (Lawrence Livermore National Lab., P.O. Box 808, L-299, Livermore, CA 94550). pp 134-138 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Development of laboratory X-ray lasers will require cavity components (mirrors, etc) able to survive intense pulses of soft x-rays. In this paper the authors examine physical processes which are likely to limit the performance of layered synthetic microstructures and establish a theoretical damage limit — .1 Joule/cm/sup 2/ for Mo-Si composites. They also examine the suitability of their general computational tools (XSN, QEOS, TKN, LASNEX) for this unusual low-temperature application.

## 4204 Heat Transfer And Fluid Flow

*REFER ALSO TO CITATION(S) 7124, 7240, 7514*

7712 **(AD-A—184783/9/XAB) Two-phase flow around a two-dimensional cylinder.** Vittal, B.V.; Tabakoff, W. (Cincinnati Univ., OH (USA)). May 1987. 9p. NTIS, PC A02/MF A01.

Pub. in AIAA Jnl., Vol. 25, No. 5, 648-654(May 1987).

The presence of solid particles in many industrial and military applications has a detrimental effect on the performance of the components. This paper presents a numerical solution for the fundamental problem of solid particles suspended in viscous incompressible flow over a cylinder at low-flow Reynolds number. The effect of solid particles on flow properties, such as streamline pattern, coefficient of drag of the cylinder, separation angle, and recirculation eddy, are discussed.

7713 **(AGARD-R—749) Future research on transonic unsteady aerodynamics and its aeroelastic applications.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Aug 1987. 45p. (CONF-8609362—). NTIS, PC A03/MF A01.

From Future research on transonic unsteady aerodynamics and its aeroelastic applications; Athens, Greece (28 Sep 1986).

The workshop focused on strategies for promoting and developing engineering level transonic flutter prediction techniques. The technology of transonic aerodynamics is currently undergoing rapid development. Significant progress is being made to solve the inherently nonlinear equations describing unsteady motions of wings in transonic flow, while the availability of reliable and efficient computational methods will greatly enhance the ability to predict the aeroelastic behavior of modern aircraft operating under transonic flow conditions.

7714 **(ESA-CR(P)—2360) Life testing program for the grooved heat pipe using the heat pipe life testing facilities. Final test of P1 and P2 after completion of the 10-year test.** Kreeb, H.; Hauser, J.; Noe, B.; Koehler, W.; Plog, C.; Schaefer, W.; Steinwandel, J. (Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.)). Jul 1986. 77p. (ETN—87-90461). NTIS, PC A05/MF A01.

Constant and variable conductance heat pipes were tested for greater than 10 yr. Both pipes show an increase of the maximum performance compared to the initial results. The maximum performance increases by 50 W. This is interpreted as a better wetting of the heat carrier which causes a higher capillary pressure. Neither pipe shows corrosion effects or a gas generation in their thermal behavior. Thus heat pipes with a material combination $NH_3$/aluminum-alloy (T6063) possess a lifetime of greater than 10 yr if a specified cleaning and filling procecure is applied.

7715 (N—87-29432, pp vp) **Transonic flow visualization using holographic interferometry.** Bryanston-Cross, P.J. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

An account is made of some of the applications of holographic interferometry to the visualization of transonic flows. In the case of the compressor shock visualization, the method is used regularly and has moved from being a research department invention to a design test tool. With the implementation of automatic processing and simple digitization systems, holographic vibrational analysis has also moved into routine nondestructive testing. The code verification interferograms were instructive, but the main turbomachinery interest is now in 3 dimensional flows. A major data interpretation effort will be required to compute tomographically the 3 dimensional flow around the leading or the trailing edges of a rotating blade row. The bolt on approach shows the potential application to current unsteady flows of interest. In particular that of the rotor passing and vortex interaction effects is experienced by the new generation of unducted fans. The turbocharger tests presents a new area for the application of holography.

7716 (N—87-29432, pp vp) **Development of laser speckle or particle image displacement velocimetry. Part 1: the role of photographic parameters.** Lourenco, L.M.M.; Krothapalli, A. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

One of the difficult problems in experimental fluid dynamics remains the determination of the vorticity field in fluid flows. Recently, a novel velocity measurement technique, commonly known as Laser Speckle or Particle Image Displacement Velocimetry became available. This technique permits the simultaneous visualization of the 2 dimensional streamline pattern in unsteady flows and the quantification of the velocity field. The main advantage of this new technique is that the whole 2 dimensional velocity field can be recorded with great accuracy and spatial resolution, from which the instantaneous vorticity field can be easily obtained. A apparatus used for taking particle displacement images is described. Local coherent illumination by the probe laser beam yielded

Young's fringes of good quality at almost every location of the flow field. These fringes were analyzed and the velocity and vorticity fields were derived. Several conclusions drawn are discussed.

7717 (N—87-29432, pp vp) **Fringe Reading Facility at the Max-Planck-Institut fuer Stroemungsforschung.** Becker, F.; Meier, G.E.A.; Wegner, H.; Timm, R.; Wenskus, R. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

A Mach-Zehnder interferometer is used for optical flow measurements in a transonic wind tunnel. Holographic interferograms are reconstructed by illumination with a He-Ne-laser and viewed by a video camera through wide angle optics. This setup was used for investigating industrial double exposure holograms of truck tires in order to develop methods of automatic recognition of certain manufacturing faults. Automatic input is achieved by a transient recorder digitizing the output of a TV camera and transferring the digitized data to a PDP11-34. Interest centered around sequences of interferograms showing the interaction of vortices with a profile and subsequent emission of sound generated by this process. The objective is the extraction of quantitative data which relates to the emission of noise.

7718 (PB—87-230496/XAB) **Vectorization of a multigrid method for the compressible Navier-Stokes equations.** Shaw, G.; Wesseling, P. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1986. 20p. (REPT—86-14). NTIS, PC E03/MF A01.

An efficient multigrid method for the solution of the compressible Navier-Stokes (CNS) equations was described by Shaw and Wesseling (1986). This algorithm was designed such that the resulting computer program was readily amenable to vectorization. The report describes the subsequent process of vectorization giving comparisons of scalar and vector timings on a CRAY-1S. Of particular interest is the vectorization of the Van Leer flux-splitting method, the implementation of which constitutes one of the most time-consuming elements in the algorithm. The program is found to run approximately three times faster in vector mode than in scalar mode.

7719 (UCID—21219) **Atmospheric heating from optical absorption by aerosols.** Chambers, D.H.; Karr, T.J. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1987. Contract W-7405-ENG-48. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88002654/JAW.

In this report, a model of aerosol heating of air is developed assuming instantaneous heating of spherical aerosol droplets. The first section presents the results for the temperature field around a spherical droplet produced by a train of heat pulses caused by absorption of a pulsed laser beam. The second section develops a statistical model of the full temperature field assuming the aerosol particle distribution can be described as a collection of Poisson points. The last section presents results for the total temperature distribution calculated for the temperature field in section 1. The model is developed for two spatial dimensions since the beam is affected only by the aerosol distribution integrated in the direction of propagation in the cases of practical interest. Generalization of this model to three spatial dimensions is straightforward.

7720 **Scaling of two-phase flow transients using reduced pressure system and simulant fluid.** Kocamustafaogullari, G.; Ishii, M. (Wisconsin Univ., Milwaukee, USA. Dept. of Mechanical Engineering; Argonne National Lab., IL, USA. Reactor Analysis and Safety Div.). *Nuclear Engineering and Design;* 104: No. 2, 121-132(Oct 1987).

Scaling criteria for a natural circulation loop under single-phase flow conditions are derived. Based on these criteria, practical applications for designing a scaled-down model are considered. Particular emphasis is placed on scaling a test model at reduced pressure levels compared to a prototype and on fluid-to-fluid scaling. The large number of similarty groups which are to be matched between modell and prototype makes the design of a scale model a challenging tasks. The present study demonstrates a new approach to this classical problem using two-phase flow scaling parameters. It indicates that a real time scaling is not a practical solution and a scaled-down model should have an accelerated (shortened) time scale. An important result is the proposed new scaling methodology for simulating pressure transients. It is obtained by considerung the changes of the fluid property groups which appear within the two-phase similarity parameters and the single-phase to two-phase flow transition prameters. Sample calculations are performed for modeling two-phase flow transients of a high pressure water system by a low-pressure water system or a Freon system. It is shown that modeling is possible for both cases for simulation pressure transients. However, simulation of phase change transitions is not possible by a reduced pressure water system without distortion in either power or time.

## 4205 Materials Testing

7721 (Y/DW—652) **Ultrasonic signal analysis of composite structures using the entire waveform.** Brosey, W.D. (Oak Ridge Y-12 Plant, TN (USA)). Aug 1986. Contract AC05-84OS21400. 21p. (CONF-8708176—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002255/JAW.

From Review of progress in quantitative NDE; La Jolla, CA, USA (3 Aug 1987).

Composite structures are often desirable for their strength and weight characteristics. Since composites are not as well characterized mechanically as metallic or ceramic structures, much work has been performed to obtain that characterization and to develop methods of determining the mechanical properties of a composite nondestructively. Most of the work in the literature to date has been performed on nonenclosed structures on which several promising nondestructive evaluation (NDE) techniques have been used to predict the integrity of the composite. An increased use of composites in enclosed geometries has led to the desire to transfer and further develop the most promising NDE techniques used on nonenclosed geometries to enclosed geometries. As part of the further development of ultrasonic inspection techniques, a high-speed data-acquisition system has been assembled which digitizes an entire rf signal waveform at each point on a Kevlar-epoxy composite structure. The complete data set of ultrasonic A-scans is then available for analysis of particular features which might ordinarily have been overlooked when only the maximum amplitude is recorded from data in a preset gate. The system provides a three-dimensional view of the data in which either the XY, YZ, or XZ planes can be displayed using pseudo color or gray scale to indicate the maximum signal amplitude in a gate set under program control. Depth information can be displayed on the XY data plane, and various image display techniques can be implemented to enhance certain material or defect conditions. 6 refs., 14 figs.

7722 (ESA-TT—1019) **Proceedings of a structural mechanics colloquium on nondestructive testing of fiber reinforced structures.** Schuetze, R.; Hillger, W.; Block, J. (European Space Agency, 75 - Paris (France)). Jan 1987. Translation of Zerstoerungsfreie Pruefung von Verbundstrukturen (DFVLR, Brunswick, West Germany), 178p (Jun 1986). (DFVLR-MITT—86-09; ETN—87-90015; CONF-8606360—). 173p. NTIS, PC A08/MF A01; original German version available from DFVLR, Cologne, West Germany DM 50.

From Structural mechanics colloquium on nondestructive testing of fiber reinforced structures; Brunswick, F.R. Germany (5 Jun 1986).

The observation of defects and their progression in carbon fiber reinforced plastics (CFRP) structures, for damage mechanics analysis of primary structures in aerospace technology is treated. Nondestructive test methods, namely ultrasonic testing, acoustic emission analysis, x-ray techniques, and an optical reflection method are presented. All these techniques prove to be well suited for investigations of damage mechanics.

## 4208 Electronic Circuits And Devices

*REFER ALSO TO CITATION(S) 7751, 7797*

**7723 (UCID—21196) Treatment of small wire loops in the method-of-moments code NEC [Numerical Electromagnetics code].** Burke, G.J. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002995/JAW.

The Numerical Electromagnetics code (NEC) is generally an accurate and versatile method-of-moments code for modeling wire antennas. NEC has been found to suffer loss of accuracy in VLF applications involving electrically small antennas, however. Some of these problems were discussed in a previous report and corrections were demonstrated to improve accuracy for open wire antennas such as dipoles. This report covers the special problems of modeling small wire loops. To model small loops the method-of-moments solution now used in NEC, with point matching and spline basis functions, was modified to use a constant loop basis function and a loop weighting function on each loop. The need for loop basis and weighting functions on small loops has been noted previously for a Galerkin method-of-moments code similar to MINI-NEC. This treatment is implemented in the NEC solution with an approximation of the loop weighting. Also, an algorithm was developed for finding and labeling loops on which the new basis and weighting functions should be applied. The option for loop basis and weighting functions has been incorporated into the code NEC3VLF which resulted from the previous VLF enhancements described. The improvement in solution accuracy and stability is demonstrated for loop antennas, loops coupled to dipoles and wire grids.

**7724 (UCRL—15960-Pt.1) Advanced numerical modeling of microwave penetration and coupling for complex structures: Quarterly report No. 1, February-May 1985.** Taflove, A.; Umashankar, K.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Electrical Engineering and Computer Science; Illinois Univ., Chicago (USA). Communications Lab.). 10 Jun 1985. Contract W-7405-ENG-48. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002577/JAW.

The goal of this research program is to develop theoretical and numerical models of microwave penetration and coupling for complex structures. These structures may have apertures, internal compartments, and wires or multiconductor cable bundles. The basic methodology is the finite difference-time domain (FD-TD) technique, developed under previous Air Force funding, and a multiconductor transmission line analysis with distributed coupling sources, developed under previous funding by the Electric Power Research Institute (EPRI). Major goals of this research program include hybridization of FD-TD with the multiconductor analysis, optimization of the FD-TD software for multiprocessing Cray supercomputers, and a user-friendly geometry-generation and output data-display methodology for FD-TD models of complex three-dimensional structures.

**7725 (UCRL—15960-Pt.2) Advanced numerical modeling of microwave penetration and coupling for complex structures: Quarterly report No. 2, June-August 1985.** Taflove, A.; Umashankar, K.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Electrical Engineering and Computer Science; Illinois Univ., Chicago (USA). Communications Lab.). 30 Sep 1985. Contract W-7405-ENG-48. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002576/JAW.

The goal of this research program is to develop theoretical and numerical models of microwave penetration and coupling for complex structures. These structures may have apertures, internal compartments, and wires or multiconductor cable bundles. The basic methodology is the finite difference - time domain (FD-TD) technique, developed under previous Air Force funding, and a multiconductor transmission line analysis with distributed coupling sources, developed under previous funding by the Electric Power Research Institute (EPRI). Major goals of this research program include hybridization of FD-TD with the multiconductor analysis, optimization of the FD-TD software for multiprocessing Cray supercomputers, and a user-friendly geometry generation and output data display methodology for FD-TD models of complex three-dimensional structures.

**7726 (UCRL—15960-Pt.5) Advanced numerical modeling of microwave penetration and coupling for complex structures: Quarterly report No. 5, April 1986 to July 1986.** Taflove, A.; Umashankar, K.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Electrical Engineering and Computer Science; Illinois Univ., Chicago (USA). Communications Lab.). Aug 1986. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002582/JAW.

The goal of this research program is to develop theoretical and numerical models of microwave penetration and coupling for complex structures. These structures may have apertures, internal compartments, and wires or multi-conductor cable bundles. The basic methodology is the finite-difference time-domain (FD-TD) technique, developed under previous Air Force funding, and multiconductor coupling analyses based upon either the integral equation approach or multi-conductor transmission line theory. The latter were developed under funding by the Air Force and the Electric Power Research Institute, respectively. Major goals of this research program currently include validation of the hybrid FD-TD/multiconductor analyses for transient (non time-harmonic) excitation of cavity geometries, investigation of the physics of coupling to wire bundles with branches and interconnections, investigation of the physics of coupling through apertures having possible depth and transverse resonances, and incorporation of special features within the overall FD-TD code, providing appropriate documentation.

**7727 (UCRL—15960-Pts.3-4) Advanced numerical modeling of microwave penetration and coupling for complex structures: Quarterly reports 3 and 4, September 1985 to March 1986.** Taflove, A.; Umashankar, K.R. (Northwestern Univ., Evanston, IL (USA). Dept. of Electrical Engineering and Computer Science; Illinois Univ., Chicago (USA). Communications Lab.). Apr 1986. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002583/JAW.

The goal of this research program is to develop theoretical and numerical models of microwave penetration and coupling for complex structures. These structures may have apertures, internal compartments, and wires or multiconductor cable bundles. The basic methodology is the finite difference - time domain technique, developed under previous Air Force funding, and multiconductor coupling analyses based upon either the integral equation approach or multiconductor transmission line theory. The latter were developed under funding by the Air Force and the Electric Power Research Institute, respectively. Major goals of this research program currently include validation of the hybrid finite-difference/multiconductor analyses for cavity geometries, investigation of thin-wall aperture physics in three dimensions, and incorporation of special features within the overall code, providing appropriate documentation.

## 4209 Waste Processing Plants And Equipment

**7728 (FRNC-R—140) Study of the advantage of energy recovery of industrial and urban wastes through pyrolyse incineration.** Pare, J.M. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 142p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88750602/JAW.

A technical and economical comparison between two pyrolytic kilns and three conventional incinerators have been carried on; pyrolytic kilns are shown to have better performances for incineration of municipal and industrial wastes. The application for hospitals and commercial centers space heating is studied after a public enquiry with these two markets have been done by mail. An economic analysis is presented.

## 4210 Combustion Systems

*REFER ALSO TO CITATION(S) 7209, 7211, 7304, 7417, 7418, 7419, 7420, 7421, 7422, 7423, 7424, 7425, 7426, 7427, 7428, 7429, 7430, 7431, 7433, 7435, 7437, 7438, 7558, 7674, 7675, 7676, 7728*

7729 (AGARD-LS—150) **Design methods in solid rocket motors.** (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Mar 1987. 239p. (CONF-8704232—; CONF-8704233—; CONF-8704234—; CONF-8704235—). NTIS, PC A11/MF A01.

From Design methods in solid rocket motors; Rijswijk, Netherlands (6 Apr 1987).

A compilation of lectures summarizing the current state-of-the-art in designing solid rocket motors and and their components is presented. The experience of several countries in the use of new technologies and methods is represented. Specific sessions address propellant grains, cases, nozzles, internal thermal insulation, and the general optimization of solid rocket motor designs.

7730 (EPRI-CS—5186, pp 2.1-2.16) **Erosion experience and prevention in industrial AFB boilers.** Stockdale, W.; Ellis, F. (Foster Wheeler Power Products, Ltd., London, England). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Three industrial atmospheric fluidized-bed boilers (AFB), installed by Gibson Wells Ltd., have been monitored in commercial operation to study the problem of erosion and to develop various prevention systems to be incorporated into future designs. To date, over 35,000 hours of operating experience have been gained, with the longest operating unit having achieved 20,000 hours of service. During this time, certain modifications to the original design philosophy have proven necessary and have resulted in constructional changes. For purposes of this investigation it was necessary to establish which areas had been most significantly affected. Eventually, erosion rates were determined and some of the main operating parameters influencing erosion established. The main factors that were identified are fluidizing velocity, or more significantly inter-tube velocity; tube geometry; and bed material composition. Other operational experience has been taken into account during the development of the various erosion prevention systems, as have the results of cold model tests undertaken by the National Coal Board (NCB) based upon the original design construction and subsequent modifications.

7731 (EPRI-CS—5186, pp 3.1-3.27) **Assessment of commercially operating fluidized-bed boilers.** Gendreau, R.J.; Raymond, D.L. (Stone & Webster Engineering Corp., Boston, MA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Fluidized-bed combustion (FBC), today's fastest-growing boiler technology, has the flexibility to burn a wide range of fuels including many wastes while satisfying all present and anticipated environmental regulations. Commercially guaranteed fluidized-bed units with steam generating rates up to 595,000-lb/hr are now operating, and units greater than 1,100,000-lb/hr have been ordered. So that they could better understand the technology and as a means of confirming the capabilities of circulating fluidized-bed (CFB) units, Stone & Webster Engineering Corporation personnel visited six CFB installations in Europe. These units are fully operative and demonstrate that CFB technology has the ability to handle a wide range of low-grade fuels while meeting fluctuating process steam demands with high reliability and reasonable O & M costs. It was also determined that much of the industrial CFB design and operating experience can reasonably be transferred to utility-scale applications. The purpose of this paper is not to make direct comparisons of one CFB design with another, but rather to present impressions of the performance and capabilities of operating CFB units based on observations and discussions with plant management operations personnel and representatives from the companies that provided the CFB units.

7732 (EPRI-CS—5186, pp 4.1-4.18) **Midwest grain products AFB boiler operating experience.** Butterworth, S.C. (Bibb and Associates, Inc., Overland Park, KS). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The Midwest Grain Products Company (Midwest) of Illinois put into operation a new fluidized-bed boiler cogeneration plant on June 19, 1984; it has now been in operation for nearly two years. This paper will analyze the performance of the Midwest plant, the operating history of each of the major systems on the boiler, and the unit availability and forced outages during the first two years of operation. Finally, the initial economics of the industrial cogeneration plant will be presented. The boiler at Midwest's plant is a fixed or bubbling-bed design. The bed consists of limestone 1/8-in to 20-mesh; the bed design depth varies from 2-3/4- to 4-ft, depending on boiler load; and the velocity of the air through the bed is approximately 4-ft per second. The figure 4-2 schematic of the air and gas systems on the Midwest boiler illustrates the major components, consisting of a forced draft (F.D.) fan, a steam coil air heater, a startup duct burner, a grid plate, a fluidized-bed combustion furnace, a convective superheater area, a boiler bank, a mechanical dust collector with fly ash reinjection system, an economizer, a baghouse, and an I.D. fan and stack.

7733 (EPRI-CS—5186, pp 8.1-8.26) **Operating experience with the Georgetown University AFBC boiler.** Burnett, R.W. (Georgetown Univ., Washington, DC). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The purpose of this paper is to describe some of the tube erosion experiences encountered with Georgetown University's atmospheric fluidized-bed combustor (AFBC). It does not intend to cover all the experiences and modifications in great detail, but rather to highlight some of the successes and failures relating to the erosion experienced in the boiler. Built by Foster Wheeler Energy Corp., it was designed to operate at 625-psi and produce 100,000 pounds of steam per hour (pph) to the University, including a major hospital. The paper shows the design parameters of the project which was funded by the Department of Energy and built at Georgetown University in order to: (1) demonstrate that a commercial 100,000-pph AFBC unit burning high-sulfur coal could be operated in a densely populated metropolitan area without having an adverse effect on the environment or the community; and (2) obtain data from the operation useful in aiding industry in the design and construction of future commercial industrial-scale AFBC generating plants. The AFBC unit began operation in 1979, and during the ensuing seven-year period has been successful in fulfilling these objectives. The unit presently has logged over 22,700 actual operating hours and will continue to supply steam for cogeneration, chillers, and thermal load.

7734 (EPRI-CS—5186, pp 9.1-9.13) **Combustion Engineering/Lurgi circulating fluidized-bed steam generator: recent applications.** Darling, S.L.; Kaupp, F.O. (Combustion Engineering, Inc., Windsor, CT). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

The circulating fluidized-bed (CFB) process is excellent for the combustion of a wide range of fuels in an economical and environmentally acceptable manner. The C-E/Lurgi CFB steam generator combines Lurgi's CFB process with steam generator components by Combustion Engineering (C-E). This paper summarizes recent applications of the technology, both industrial and utility.

7735 (EPRI-CS—5186, pp 10.1-10.11) **FBC startup and operational experience on seven fluidized-bed boilers at Campbell Soup Company.** Blakesley, L.L. (Campbell Soup Co., Camden, NJ). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

In early 1980 Campbell Soup Company made the decision to install seven 50,000-pound-per-hour (pph) fluidized-bed boilers manufactured by the Johnston Boiler Company, now Stone Johnston Corporation. The four boilers at the Napoleon, Ohio plant together with another at the Salisbury, Maryland plant were installed to replace existing heavy oil-fired boilers. The Maxton, North Carolina plant was constructed from the ground up, and the three boilers used there are the only source of steam for the plant. All locations used similar support equipment which included a deaerator and feedwater economizers to each boiler, a pulse-jet baghouse in each boiler flue gas stream, a light-phase pneumatic ash conveying system, conventional bucket elevator with drag or screw conveyor coal handling equipment, a pneumatic conveying system to fill limestone silos and bunkers, light source optical density opacity systems, and extractive-type $SO_2$ monitoring equipment. Currently, almost 100,000 hours of operation have been logged on the seven fluidized-bed boilers since startup. Design modifications to the boiler, the baghouse, and to the pneumatic ash handling, coal handling, limestone handling, and emissions monitoring equipment were made to improve performance and reliability. The major problem areas and the evolution up to the latest modifications will be discussed. A cutaway drawing of the boiler is provided as figure 10-1 for clarity during this discussion.

7736 (EPRI-CS—5186, pp 11.1-11.20) **Improving the performance of fluidized-bed boilers at Canadian Forces Base Summerside.** Razbin, V.V.; Friedrich, F.D. (DOE Mines and Resources, Ottawa, Ontario). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Canada's first coal-fired fluidized-bed boilers were installed in 1982 at the heating plant for Canadian Forces Base Summerside in the Atlantic province of Prince Edward Island. The demonstration project was jointly funded by Defense Canada and Energy, and Mines and Resources Canada. Foster Wheeler, Ltd. of St. Catherines, Ontario was the prime contractor with responsibility for supplying a turnkey heating plant, including two boilers rated at 18-tph (40,000-lb/hr) of steam each. The boilers subsequently met all contractual requirements pertaining to capacity, efficiency, and emissions; however, some problems emerged with respect to boiler tube erosion and other aspects of boiler operability. This paper describes four areas of difficulty and how they are being resolved.

7737 (EPRI-CS—5186, pp 14.1-14.20) **Integration of a circulating fluidized-bed steam generator with the balance-of-plant in a utility environment.** Gotlieb, J.M. (Stearns Catalytic Corp., Denver, CO). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

This paper will explore the application of fluidized-bed boiler technology to the utility power plant environment. The Nucla CFB demonstration project will be utilized as the model for this topic. Specifically, the plant engineering aspects of process and physical plant design to support a fluidized-bed boiler in a utility environment will be explored. This paper is for presentation at the Seminar on Atmospheric Fluidized-Bed Technology for Utility Applications, sponsored by the Electric Power Research Institute (EPRI) on April 8-10, 1986 in Palo Alto, California.

7738 (EPRI-CS—5186, pp 15.1-15.9) **Conversion of four pulverized coal units to AFBC boilers by Wisconsin Electric Power Company.** Childress, N.B. Jr. (Wisconsin Electric Power Co., Milwaukee). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

Wisconsin Electric Power Company's Oak Creek Power Plant (OCPP) consists of eight coal fired units ranging in size from 120-MWe to 310-MWe which went on line between 1953 and 1967. It is divided into two distinct plants: the north plant and the south plant. The North Plant units currently are pulverized coal-fired and were placed on line in 1953, 1954, 1955, and 1957. Units 1 and 2 are nominally rated at 120-MWe (gross); units 3 and 4 are rated at 130-MWe (gross). OCPP is planning conversion of units 1 through 4 from pulverized coal (PC) firing to atmospheric fluidized-bed combustion (AFBC). The equipment to be replaced is included in the boiler island from the inlet of the forced draft fans to the chimneys, and also includes portions of the coal and ash handling facilities. In addition, a new sorbent handling system will be built. The turbine/generators, condensate systems, lighting, feedwater heaters, controls, and other auxiliaries will undergo an extensive rehabilitation program. The conversion will be accomplished two units at a time, with units 3 and 4 being converted initially in July 1989 and January 1990, respectively. Units 1 and 2 will be converted next, with completion dates in July 1992 and January 1993, respectively.

7739 (EPRI-CS—5186, pp 26.1-26.26) **Combustion of Colorado-Ute coal in a 1.5-MW/sub t/ ahlstrom pyroflow pilot plant.** Tang, J.; Isaksson, J.; Engstrom, F. (Pyropower Corp., San Diego, CA). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

In 1983 Colorado-Ute Electric Association (CUEA) contracted with Pyropower Corporation to design and build an Ahlstrom Pyroflow circulating fluidized-bed boiler (CFB) for burning Colorado bituminous coal. This utility-size Pyroflow boiler will produce 117-kg/s superheated steam at 105-bar and 540°C which generates 110-MW electrical output for CUEA's Nucla generating station in Nucla, Colorado. In support of this project CUEA and the Electric Power Research Institute (EPRI) sponsored a series of tests in a 1.5-MW/sub t/ Ahlstrom Pyroflow pilot plant at the Hans Ahlstrom Laboratory (HAL) in Karhula, Finland. The tests were aimed at investigating performance data for two different limestones and obtaining necessary information for the Pyroflow boiler design. Thirty-two (32) tons of Colorado bituminous coal and three (3) tons of two different limestones were shipped to Karhula via sea cargo. One of the limestones, labeled CU-400, was taken from the sludge residue of a sugar processing operation, was highly reactive, and contained a high percentage of fines below 40-microns. The other limestone (CU-200) was a normal, high-grade limestone containing 97% $CaCO_3$.

7740 (EPRI-CS—5186, pp 28.1-28.17) **Computer simulation of mixing phenomena in AFBC boilers.** Domanus, H.M.; Schmitt, R.C.; Sha, W.T.; Petrill, E.M.; Howe, W.C.; Bass, J.W. (Argonne National Lab., IL). Jul 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI87920515/JAW. (CONF-8604340—).

From Seminar on atmospheric fluidized-bed combustion technology for utility applications; Palo Alto, CA, USA (8 Apr 1986).

A model has been developed to investigate the detailed thermal hydraulic mixing phenomena in an atmospheric fluidized bed combustor. The model is fully three-dimensional and transient. The solution of the conservation equations for mass, momentum, and energy as a boundary value problem in space and an initial value problem in time are embodied in the COMMIX computer code. The model has been applied to investigate several different overfire air port configurations to assess the impact of the thermal

mixing processes. The results graphically show the usefulness of such analysis to design considerations.

7741 **(N—87-28883) Thin film strain gage development program. Final program.** Grant, H.P.; Przybyszewski, J.S.; Anderson, W.L.; Claing, R.G. (Pratt and Whitney Aircraft Group, East Hartford, CT (USA)). Dec 1983. 194p. (NASA-CR—174707; NAS—1.26:174707; PWA—5628-69). NTIS, PC A09/MF A01.

Sputtered thin-film dynamic strain gages of 2 millimeter (0.08 in) gage length and 10 micrometer (0.0004 in) thickness were fabricated on turbojet engine blades and tested in a simulated compressor environment. Four designs were developed, two for service to 600 K (600 F) and two for service to 900 K (1200 F). The program included a detailed study of guidelines for formulating strain-gage alloys to achieve superior dynamic and static gage performance. The tests included gage factor, fatigue, temperature cycling, spin to 100,000 G, and erosion. Since the installations are 30 times thinner than conventional wire strain gage installations, and any alteration of the aerodynamic, thermal, or structural performance of the blade is correspondingly reduced, dynamic strain measurement accuracy higher than that attained with conventional gages is expected. The low profile and good adherence of the thin film elements is expected to result in improved durability over conventional gage elements in engine tests.

## 4240 Pollution Control Equipment

*REFER ALSO TO CITATION(S) 7437, 7440*

7742 **(PB—88-101795/XAB) Development of NOx control methods for glass-melting furnaces. Final report, August 1984-December 1986.** Abbasi, H.A.; Fleming, D.K. (Institute of Gas Technology, Chicago, IL (USA)). Aug 1987. 125p. NTIS, PC A06/MF A01.

See also report dated Sep 1983, PB—84-186923.

This report discusses the results of combustion modification field tests for control of NO(x) emissions from glass-melting furnaces. The techniques were developed on a pilot-scale glass-tank simulator resulting in generalized correlations between NO(x) formation and port design and operating parameters. Two commercial-container glass-melting furnaces were tested - a 165 ton/day endport furnace and a 250 ton/day sideport furnace. Data from both commercial furnaces obeyed the generalized correlations for NO(x) formation as a function of air preheat temperature and excess air utilization. The endport furnace data confirmed the combustion geometry correlations, with a scale-up factor. By application of the emission control techniques to the endport furnace, it was possible to reduce the emissions to the range of 4.5 to 5.5 pounds of NO(x) per net ton of glass from the baseline levels of 7 to 8 pounds of NO(x) per ton of glass. Application of the NO(x) control techniques to the 4-port sideport furnace was, however, not effective in reducing the NO(x) production to low levels, primarily because furnace-design constraints prohibited the achievement of the necessary long, lazy flames. The report reviews the generalized correlations, discusses the techniques for using these generalizations for emissions reduction during operation, and indicates the direction for furnace design that should minimize NO(x) production.

7743 **(PB—88-102736/XAB) Microscopic evaluation of efficiency theory for electrostatic precipitators.** Yamamoto, T. (Research Triangle Inst., Research Triangle Park, NC (USA)). Sep 1987. 13p. NTIS, PC A03/MF A01.

This paper discusses a microscopic evaluation of efficiency theory for electrostatic precipitators. A wire-plate configuration is selected, and the position dependence of migration velocity, concentration profiles, and fractional-collection efficiency is discussed. Several efficiency theories, including non-Deutchian phenomena, have appeared over the years. Among all existing theories, effective migration is the quantity in dispute and not the theoretical migration velocity. The particle-migration velocity cannot be a single number but is rather a function of position. The local migration velocity is essential to calculate the concentration profile. Therefore, the theoretical treatment of particle motion in the electrohydrodynamic field is a necessary step in understanding the microscopic precipitation process and efficiency theory.

# 43 PARTICLE ACCELERATORS

*REFER ALSO TO CITATION(S) 7645, 8187*

## 4301 Design, Development, And Operation

*REFER ALSO TO CITATION(S) 7987*

7744 **(NAC-RR—660) National Accelerator Centre neutron therapy facility: description and preliminary data.** Jones, D.T.L.; Hendrikse, W.L.J.; Yudelev, M. (Council for Scientific and Industrial Research, Faure (South Africa). National Accelerator Centre). 1987. 34p. CSIR, National Accelerator Centre, P.O. Box 72, Faure, 7131, South Africa.

The isocentric neutron therapy facility at the National Accelerator Centre has been operational since February 1987. Neutrons are produced by the p(66 MeV)/Be(40 MeV) reaction. Field sizes between 5 x 5 cm/sup 2/ and 30 x 30 cm/sup 2/ are defined by a rotatable continuously variable collimator. A manually activated moving floor permits gantry rotation of +-185. Initial commissioning tests indicate satisfactory performance of the facility. Basic neutron beam data have been measured in order to provide sufficient information for radiobiological experiments to be undertaken. The total dose rate at the dose maximum in water for a 10 x 10 cm/sup 2/ field at the SSD of 150 cm is 1.98 cGy.min/sup -1/.μA/sup -1/. Dose rates of 50 cGy.min/sup -1/ are routinely achieved. The gamma contamination is estimated to be 3.5% at dose maximum increasing to 6.2% at 10 cm depth in water for a 10 x 10 cm/sup 2/ field. The physical characteristics of the beam are very similar to those of 8 MV photons and compare favourably with those of other high energy neutron therapy facilities.

7745 **(TRI-PP—87-60) The TRIUMF KAON factory.** Kitching, P. (TRIUMF, Vancouver, British Columbia (Canada)). Jul 1987. 7p. (CONF-8706166—7). NTIS, PC A02. Order Number DE88900163/JAW.

From International symposium on medium energy physics; Beijing, China (23 Jun 1987).

The TRIUMF KAON factory is intended to provide a 100μA beam of 30 GeV protons, in order to produce intense, clean beams of secondary particles, particularly kaons, antiprotons and neutrinos. It can be compared with presently available machines, such as the Brookhaven AGS (30 GeV, 0.7 μA to be upgraded to 2 μA and KEK (12 GeV, <1 μA). The object is to carry out experiments in both particle and nuclear physics which are complementary to those carried out on the "high energy" frontier. 10 figs., 1 tab.

7746 **Software development for the SSC.** Appel, J.A.; Day, C.; Linglin, D.; Loken, S.; Le Brun, P.; May, E.; Shapiro, M.; Zajc, W. (Fermilab). pp 315-320 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

This note deals with proposed software development methodologies for SSC experiments. While these techniques are being discussed under the auspices of the Offline Computing and Networking group, it is essential to realize that such methods are best applied in a global fashion, so that they may also be applied to the on-line software efforts, as well as to software being developed for Monte Carlo and design purposes.

## 4302 Beam Dynamics, Field Calculations, And Ion Optics

*REFER ALSO TO CITATION(S) 7755*

**7747 (GSI—87-13) Simulation of space charge effects in RFQ-MAXILAC.** Warwick, A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jul 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751278/JAW.

Some improvements have been made to the computer program PARMTEQ and it has been used to study beam dynamics in the heavy ion MAXILAC. The measured performance of the 5 tank prototype can be understood reasonably well in terms of emittance growth and losses due to space charge, although the measured maximum transmission is worse than predicted. Two different methods of calculating the space charge forces have been developed to the point of giving similar results. The sensitivity of the prototype structure to mechanical misalignments is discussed. Comparisons are made with existing light ion RFQ accelerators, which generally give brighter beams, and understood in terms of the maximum achievable voltage. All simulations are for Argon 1/sup +/ and are easily scaled for other ions. (orig./HSI).

## 4303 Auxiliaries And Components

*REFER ALSO TO CITATION(S) 7694, 7761, 7761, 7787, 7788, 7795, 8371*

**7748 (CONF-870610—14) An overview of the advanced photon source.** Shenoy, G.K.; Moncton, D.E. (Argonne National Lab., IL (USA); Exxon Research and Engineering Co., Annandale, NJ (USA)). Aug 1987. Contract W-31109-ENG-38. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003076/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

The need for dedicated synchrotron radiation facilities based on insertion devices and a low emittance storage-ring has been recognized for many years. A facility optimized to produce x-rays from 1 to 100 keV is expected to dramatically enhance research capabilities in the areas of condense matter physics, material sciences, chemical sciences, and biological sciences, in addition to contributing in a major way to the industrial research. This goal will be accomplished by the construction of the Advanced Photon Source (APS) facility consisting of a 7-GeV positron storage-ring with 100 mA current and 35 straight-sections to accommodate insertion devices. The ring energy has been chosen so that a single undulator will provide radiation from 4 to 40 keV (using the first and the third harmonics) with 0.2% bandwidth. The low emittance of 7 x $10^{-9}$ rad . m will provide hard-x-ray undulator radiation with very high brilliance ($\sim 10^{18}$ to $10^{19}$ photons/(s mm$^2$ mrad$^2$)). (Construction is expected to begin in 1989 at Argonne National Laboratory.) This overview will mainly address the facility from the users' point-of-view.

**7749 (CONF-870610—15) The effect of random field errors on the radiation spectra of selected APS [Advanced Photon Source] undulators.** Alp, E.E.; Viccaro, P.J. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003077/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

The effect of random magnetic field errors are introduced into the calculations of spectral characteristics of tunable undulators for the proposed 7 GeV Advanced Photon Source (APS). Single electron calculations are made for an undulator with a first harmonic radiation tunable between 3.5 and 13 keV. Using the universal curves developed by Kincaid, the effect of randomly distributed field errors on the first and third harmonics of two proposed typical undulators are calculated. It is found that the lower limit of 0.5% in field errors is more than sufficient for the successful operation of the undulators planned for the APS.

**7750 (FNAL-TM—1480) A programmable finite state module for use with the Fermilab Tevatron Clock.** Beechy, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 5p. (CONF-8709151—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002656/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

A VME module has been designed which implements several programmable finite state machines that use the Tevatron Clock signal as inputs. In addition to normal finite state machine type outputs, the module, called the VME Finite State Machine, or VFSM, records a history of changes of state so that the exact path through the state diagram can be determined. There is also provision for triggering and recording from an external digitizer so that samples can be taken and recorded under very precisely defined circumstances.

**7751 (FNAL-TM—1488) Fermilab accelerator control system: Analog monitoring facilities.** Seino, K.; Anderson, L.; Smedinghoff, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 5p. (CONF-8709151—6). NTIS, PC A02. Order Number DE88002839/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

Thousands of analog signals are monitored in different areas of the Fermilab accelerator complex. For general purposes, analog signals are sent over coaxial or twinaxial cables with varying lengths, collected at fan-in boxes and digitized with 12 bit multiplexed ADCs. For higher resolution requirements, analog signals are digitized at sources and are serially sent to the control system. This paper surveys ADC subsystems that are used with the accelerator control systems and discusses practical problems and solutions, and it describes how analog data are presented on the console system.

**7752 (FNAL-TM—1489) Updated overview of the Tevatron control system.** Lucas, P. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 6p. (CONF-8709151—5). NTIS, PC A02. Order Number DE88002840/JAW.

From Europhysics conference on control systems for experimental physics; Villars, Switzerland (28 Sep 1987).

A single unified control system is used for all of the Fermilab accelerators and storage rings, from the LINAC to the Tevatron and antiproton source. A review of the general features is given - these include a 'host' system consisting of a number of minicomputers integrated with many distributed microprocessors in a variety of subsystems, usage of an in-house developed protocol, GAS, for communication between the two classes of machines, and a Parameter Page program, designed in conjunction with the system database, which allows a wide variety of quantities to be read and set in a coherent fashion. Recent developments include the implementation of a block transfer and 'fast time plot' facility through CAMAC, inclusion of several new computers in the host, a better understanding of system throughput, greatly improved reliability, advent of programs which sequence a large number of independent operations, and the construction of new hardware subsystems. Possible future system upgrades will be briefly presented. A summary of the utilization of a quite large software staff, at a time when the system is no longer under construction, will be discussed.

**7753 (INIS-mf—10769) Development of a novel 7-split resonator for the acceleration of heavy ions.** Grieser, M. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 82p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751293/JAW.

In order to increase the energy of the heavy ion beams with mass numbers from A=2 until about A=60 in the Heidelberg post-accelerator further resonators can be applied in its beam back-transport. For this a novel 7-split resonator for the synchrotron velocity $\beta/\text{sub s}/ = 0.17$ was developed. Contrarily to the many-split resonators which are composed of nearly unmodified spiral-cable oscillators the new developed 7-split resonator possesses only one reso-

nance structure. By this a high electromagnetic efficiency is reached. In the construction of this resonance structure cared was about high shunt impedance as well as high mechanical stability which is manifested by an excellent fitting and a reliable operation of the resonator. The resonance structure allows a very simple tuning and facilitates the setting up and calibration. First comprehensive studies were performed on a low-power model in the scale 1:2.5. By superposition of two eigenoscillations a push-pull was produced which exhibits the voltage distribution required for the particle acceleration. On the low-power model a shunt impedance of 45+-1.8 MΩ/m was measured. Disturbance studies in the power resonator yielded a shunt impedance of Z = 30+-1.2 MΩ/m. The value is in remarkable agreement with the shunt impedance of 28.5+-1.1 MΩ/m extrapolated from low-power measurements. At an entrance power of 80 kW a resonator voltage of 1.9 MV results. In calibration measurements with a deuteron beam a shunt impedance of 27.6+-1.1 MΩ/m resulted. The power resonator was submitted to a high-power test of a period of 450 hours at a maximal power of 100 kW (1:4 touched) which demonstrated the unconstrained function ability.

7754 **(SLAC-PUB—4437) The Stanford Linear Collider positron source.** Ecklund, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 5p. (CONF-8706219—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002563/JAW.

From Intense positron beam workshop; Idaho Falls, ID, USA (18 Jun 1987).

A description of the positron source used in the Stanford Linear Collider is given. The performance to date is reviewed.

7755 **(UCRL—94583) Free electron laser amplifier driven by an induction linac.** Neil, V.K. (Lawrence Livermore National Lab., CA (USA)). 3 Jun 1986. Contract W-7405-ENG-48. 25p. (CONF-860756—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002452/JAW.

From NATO advanced course on high brightness accelerators; Pitlochry, Scotland (13 Jul 1986).

This paper discusses the use of a free-electron laser amplifier as a means of converting the kinetic energy of an electron beam into coherent radiation. In particular, the use of an induction linear accelerator is discussed. The motion of the elections in the tapered and untapered wiggler magnets is discussed as well as the beam emittance, and the radiation fields involved. (LSP)

7756 **Status report on ANL computer-controlled target storage system.** Klimczak, G.W.; Nardi, B.G.; Travis, D.J. (Argonne National Lab., IL, USA). *Nuclear Instruments and Methods in Physics Research;* **257**: No. 1, 57-59(1 Jun 1987). (CONF-860939—). Contract W-31-109-ENG-38.

From 13. world conference of the Nuclear Target Development Society; Chalk River, Canada (17 Sep 1986).

A previous paper has discussed the computer controlled target storage system designed and built at Argonne National Laboratory. This preliminary system is now in operation, it provides protection to targets during power failures, and places the system in a safe shutdown mode. The system recovers upon power restoration, thereby restoring the system to the normal mode. The target storage facility permits user access while protecting targets in the chamber. A status report will be given on the present system operation as well as the results of operational testing. In addition, the results of operational testing problems associated with making the system fully operational under computer control will be discussed. Some of the problems, and potential solutions, under investigation will be discussed.

7757 **Future computer networking facilities for remote access of SSC data.** Chartrand, G. (Fermilab, P.O. Box 500, Batavia, IL 60510). pp 283-288 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

There will be new communications services available for use within the time of the SSC taking data. It will be important for one to track these services so that the strategy for providing remote networking can be adapted.

7758 **Offline computing and networking.** Appel, J.A.; Avery, P.; Chartrand, G.; Day, C.T.; Gaines, I.; Georgiopoulos, C.H.; Gilchriese, M.G.D.; Goldman, H.; Hoftun, J.; Linglin, D. pp 269-282 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The crucial ingredient in the model of a central computing facility for the SSC, is the reliance on cheap farms of microprocessors for most of the computing needs. It is clear that without the implementation of such farms, either within high energy physics or by industrial sources, SSC computing cannot be done without an enormous and unacceptable increase in the cost. We must have both the hardware and software ability to make microprocessor farms work. The other components of the model appear to be well within reasonable extrapolations of today's computing related technology.

7759 **Data processing in AGS experiment 780.** Morse, W.M.; Jastrzembski, E.; Larsen, R.C.; Leipuner, L.B.; Adair, R.K.; Greenlee, H.; Kasha, H.; Mannelli, E.; Mannelli, M.; Schaffner, S. (Brookhaven National Lab., Upton, NY 11973). pp 261-268 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The Brookhaven National Laboratory is preparing a seven segment Brookhaven Fastbus system for AGS experiment 780. The data is filtered and buffered in a two megabyte Fastbus memory. Parallel processing will occur in the TDC spy, Fastbus list processor, J11 processor and PDP 11/44 host computer.

7760 **Level 3 filters at CDF.** Carroll, J.T. (Fermilab, P.O. Box 500, Batavia, IL 60510). pp 254-260 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The Level 3 stage in CDF online filtering is currently under development. This system should support a flexible division between online and offline software filters within the constraints of the full data acquisition system. Multimicroprocessor (MMP) structures like the ACP system used by CDF could be improved with multi-rank architectures to meet SSC requirements.

## 4304 Storage Rings

*REFER ALSO TO CITATION(S) 7748*

7761 **(FNAL-TM—1491) Report of the New Rings Study Group.** Holmes, S.D.; Dugan, G.; Marriner, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 19 Oct 1987. Contract AC02-76CH03000. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002842/JAW.

We have taken the approach here of trying to understand both the feasibility and practicality of varied options for new rings at Fermilab, rather than trying to produce a single detailed design. In other words, this document is not a design report and should not

be construed as such. Our perception of the potential needs for new rings (in order of priority) is as follows: Antiproton Storage and/or Recovery: A facility for storing up to 4 x $10^{12}$ antiprotons is needed. Recovery of antiprotons from the collider becomes a viable option if the luminosity is indeed dominated by emittance dilution rather than beam loss. New or Post-Booster: The goal here would be to inject into the existing Main Ring above transition. Improved performance of the Main Ring would be anticipated. New Main Ring: Advantages would include better emittance preservation, a faster cycle time for antiproton production, and the removal of interference/backgrounds at the B0 and D0 detectors. We discuss in this paper various scenarios based on one or more combinations of the above possibilities. 14 figs., 10 tabs.

7762 **(KEK—87-2) First results from the AMY detector at TRISTAN.** (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). May 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751456/JAW.

Bhabha scattering and multi-hadronic e/sup +/e/sup -/ annihilation events have been observed in the AMY detector at $\sqrt{s}$ = 50 GeV at the TRISTAN e/sup +/e/sup -/ storage ring. Here we report the results of a preliminary analysis of the properties of these events. Of particular note is one event that contains a high energy, isolated gamma ray together with a large amount of missing momentum that penetrates the fiducial volume of the detector.

7763 **(KEK—87-4) Construction of a higher-order-mode coupler and its performance.** Tokumoto, S.; Izawa, M.; Sakanaka, S.; Kobayakawa, H. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Jun 1987. 26p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751457/JAW.

Beam instabilities, driven by the high impedances of the rf-accelerating cavities, limit performance of the stored beam in the Photon Factory storage ring. A damping coupler, to reduce the higher-order-mode impedances, was constructed and tested. Details of design works and its high-frequency characteristics are described. After a test with high rf-power (500 MHz, 60 kW cw) at a test bench, the coupler was inserted in the cavity in the storage ring. No problems arose in operating with a high-current beam and a single-bunched beam. The thresholds of the instabilities were largely improved as we expected.

# 44 INSTRUMENTATION

## 4401 Radiation Instrumentation

*REFER ALSO TO CITATION(S) 7504, 7759, 7760, 7855, 7895, 7979, 7989, 8003, 8004, 8068, 8156, 8164, 8371*

7764 **(ANL-HEP-CP—87-84) Calculation of the potentials and 3D electric fields in a proton decay detector.** Lari, R.J.; Dawson, J.W.; Turner, L.R. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. (CONF-870806—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002986/JAW.

From 6. conference on the computation of electromagnetic fields; Graz, Austria (25 Aug 1987).

An electrostatic detector for measuring the lifetime of the proton has been modeled in three dimensions. Linear hexahedral finite elements were used and the potential obtained at all nodes. The three components of the electric field were calculated and used to determine field lines, calculate drift fields and drift times. Effective aperture calculations agreed with the measurements.

7765 **(CRN-HE—87-01) Ring imaging Cherenkov detector the Delphi barrel rich prototype. Part A: experimental studies of the detection efficiency and the spatial resolution.** Arnold, R.; Baillon, P.; Besch, H.J. and others. (Strasbourg-1 Univ., 67, France. Centre de Recherches Nucleaires; CERN, Geneva, Switzerland; College de France, 75 - Paris). (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). 1987. 57p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751373/JAW.

We discuss in two parts the latest DELPHI Barrel RICH Prototype test results. This first part, after a technical description of the prototype, is devoted to detailed experimental studies of the multiwire detector response, associated analogue electronics and of the photoelectron collection in the drift volumes. Emphasis is given to the single electron detection efficiency problem and to the accuracy of the tri-dimensional photoconversion space point reconstruction. Limitations of the technique and their solution are discussed. Finally a measurement of the longitudinal diffusion coefficient for several gas mixtures is given.

7766 **(EUR—10403) Results of the second CEC intercomparison of active and passive dosimeters for the measurement of radon and radon decay products.** Miles, J.C.H.; Sinnaeve, J. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements; Commission of the European Communities, Luxembourg). 1986. 64p. Commission of the European Communities, Luxembourg.

In 1982 the Commission of the European Communities (CEC) sponsored an international intercomparison of passive and active techniques of measuring the concentrations of radon and its decay products. The exercise was repeated in 1984, when 17 laboratories participated in the intercomparison of passive dosimeters and 13 in the intercomparison of active measurement techniques. Most of the exposures were carried out in a 43 m/sup 3/ environmental chamber at NRPB Chilton. The intercomparison was carried out as part of a wider international programme sponsored jointly by the CEC and the Nuclear Energy Agency of the Organization for Economic Cooperation and Development. The intercomparison of active measurement techniques was carried out over three days, different exposure conditions being provided on each day. The results for radon decay product measurements showed a significant improvement on those in the 1982 intercomparison. In the 1982 exercise there was an overall spread of 57% about the mean and a standard deviation of 15% when radon was in equilibrium with its decay products. Under similar conditions in the second intercomparison, the overall spread was 29% and the standard deviation 10%. The results of the passive dosimeters showed that those who participated in both the 1982 and 1984 intercomparisons maintained a similar standard in both. Some newcomers to the intercomparison in 1984 had dosimeters which performed well, but some were troubled by high background track densities which made measurement of low exposures difficult.

7767 **(INIS-mf—10758) Event structures of neutrino-induced reactions in the scintillation detector KARMEN-1.** Raupp, F. (Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). 19 Dec 1986. 114p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751282/JAW.

For the simulation of neutrino-induced reactions in the scintillation detector KARMEN-1 a Monte Carlo program was developed. This program allows the simulation of the detection reactions of the neutrino reactions possible at the spallation neutron source ISIS at the Rutherford Appleton Lab., as well as the detection of neutrino oscillations $\nu$/sub $\mu$/ -> $\nu$/sub e/ respectively anti $\nu$/sub $\mu$/ -> anti $\nu$/sub e/ and the inelastic neutrino-nucleus scattering. By means of test measurements on prototype detectors the specific parameters for the simulation were determined. From the calculations the detection probabilities of the reactions could be determined. Thereby realistic cuts on the data were regarded which are necessary to the background reduction. From the many single results the good energy resolution for 15-eV gammas from the decay of the /sup 12/C nucleus excited in an inelastic neutrino-nucleus scattering should be mentioned. Regarding the passive material necessary for the construction of the detector results averaged over the whole detector an energy resolution of 15.0%. For the examination of the assumptions which enter the Monte Carlo simulation as well for the fitting of the parameters to realistic conditions in the KARMEN experiment measurements on the test module were performed. These measurements confirmed the space-dependent light-yield function used in the calculations. Simultaneously on the test module the energy resolition could be determined: $\sigma$ = 12.3%/$\sqrt{E(Mev)}$ for the sum of the signals from both module ends. A

similar resolution is also to be expected for the modules of the large detector because they differ only in details from the test module.

7768 (INIS-SU—431, pp 589) **Radiation level indicators on the base of photoelements.** Bogatov, V.N.; Kovtun, V.E.; Nagajchenko, V.I.; Cherkasov, A.S.; Shevchenko, A.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

7769 (LBL—23961) **Detection of minimum-ionizing particles in hydrogenated amorphous silicon.** Kaplan, S.N.; Fujieda, I.; Perez-Mendez, V.; Qureshi, S.; Ward, W.; Street, R.A. (Lawrence Berkeley Lab., CA (USA); Xerox Palo Alto Research Center, CA (USA)). Sep 1987. Contract AC03-76SF00098. 15p. (CONF-8709153—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002769/JAW.

From Conference on position-sensitive detectors; London, UK (7 Sep 1987).

Based on previously-reported results of the successful detection of alpha particles and 1- and 2-MeV protons with hydrogenated amorphous silicon (a-Si : H) diodes, detection of a single minimum-ionizing particle will require a total sensitive thickness of approximately 100 to 150 μm, either in the form of a single thick diode, or as a stack of several thinner diodes. Signal saturation at high dE/dx makes it necessary to simulate minimum ionization in order to evaluate present detectors. Two techniques, using pulsed infrared light, and pulsed x-rays, give single-pulse signals large enough for direct measurements. A third, using beta rays, requires multiple-transit signal averaging to produce signals measurable above noise. Signal amplitudes from the a-Si : H limit at 60% of the signal size from Si crystals extrapolated to the same thickness. This is consistent with an a-Si : H radiation ionization energy, W = 6 eV/electron-hole pair. Beta-ray signals are observed at the expected amplitude.

7770 (PITHA—87/06) **Study of the signal shape, drift velocity, diffusion, and spatial resolution in different gas mixtures.** Krause, B.; Masson, S. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). Apr 1987. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751300/JAW.

The aim of the present work was to study with a drift chamber pulse shape, drift velocity, diffusion, and spatial resolution in different gas mixtures. By means of our apparatures (mixing facility, closed gas system) pure gas mixtures could be prepared with high constancy in all parameters the qualitative and quantitative composition of which was currently monitored during the experiment (hygrometer, gas chromatograph). Therefore it was possible to reproduce the drift velocity in the promille range. In all tested gas mixtures the drift velocities have been determined with the gigaflash ADC which agree well with the literature values. Because the electronic time resolution extends in its order of magnitude to 1 ns the good spatial-resolution value of 77 μm in the gas with the highest drift velocity (Ar/C/sub 2/H/sub 6/ 50/50, v/sub D/ = 50 μm/ns) is yet evident. After exchange of the argon by the heavier rare gas xenon the spatial resolution deteriorated in spite of smaller drift velocity. That a lower drift velocity is not equivalent with a better spatial resolution could be also shown in 'cold' gas mixtures. In the CO/sub 2/ mixtures the isobutane contribution was replaced by lower alkanes because of an assumed ageing effect which can make the chamber unusable, by which the resolution values became worse. (orig./HSI).

7771 (SLAC-PUB—4399) **Factors affecting the response of the bubble detector BD-100 and a comparison of its response to CR-39.** Ipe, N.E.; Busick, D.D.; Pollock, R.W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Siemens Gammasonics, Des Plaines, IL (USA)). Aug 1987. Contract AC03-76SF00515. 9p. (CONF-871020—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003260/JAW.

From 6. symposium on neutron dosimetry; Neuherberg, F.R. Germany (12 Oct 1987).

The BD-100 is a bubble detector available commercially from Chalk River Nuclear Laboratories, Canada for neutron dosimetry. According to the manufacturer, the BD-100 detects neutrons over an energy range of 100 keV to 14 MeV and the dose equivalent response is independent of energy. The sensitivity of the detector is dependent upon its temperature at the time of irradiation. The sensitized detector self-nucleates upon sharp impact and when heated to temperatures of 48°C or greater. The BD-100 is insensitive to low energy gamma rays but responds to 6 MeV photons. The sensitivity (bubbles/μSv) of the BD-100 was found to be energy dependent when exposed to standard neutron sources with average energies ranging from 0.5 to 4.5 MeV. The bubbles formed upon irradiation continued to grow in size with time. The response of electrochemically etched CR-39 to the same neutron sources is also reported for comparison.

7772 **Expert system for fastbus diagnosis.** Booth, A.W.; Carroll, J.T. (Fermi National Accelerator Lab., Batavia, IL, USA). *Computer Physics Communications;* 45: No. 1-3, 67-76(Aug 1987). (CONF-870249—).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The complexity of the FASTBUS network at CDF makes access to expert assistance a necessity for efficient operation. A software Expert System has been proposed to diagnose FASTBUS errors and advise users on recovery options in the interactive DAQ environment. This paper introduces some basic features of rule-based programming and uses examples to describe how expert systems function. A prototype system, FBEXPERT, has been developed using a language called OPS5 and applied to the diagnosis of a network problem. This paper includes an example which shows how the system updates its knowledge base at it proceeds to the correct solution.

7773 **Status of (US) high energy physics networking.** Montgomery, H.E. (Fermi National Accelerator Lab., Batavia, IL, USA). *Computer Physics Communications;* 45: No. 1-3, 77-82(Aug 1987). (CONF-870249—).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The current status of networking to and between computers used by the high energy physics community is discussed. Particular attention is given to developments over the last year and to future prospects. Comparison between the current status and that of two years ago indicates that considerable strides have been made but that much remains to be done to achieve an acceptable level of functionality.

7774 **Data management for high energy physics experiments - preliminary proposals.** Olken, F.; Loken, S.C.; Rotem, D.; Shoshani, A.; Trippe, T.G. (Lawrence Berkeley Lab., CA, USA). *Computer Physics Communications;* 45: No. 1-3, 379-383(Aug 1987). (CONF-870249—). Contract AC03-76SF00098.

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Currently HEP experimental data are reduced as they become available. We propose instead a "demand driven" approach to data analysis. Full analysis will be performed only as needed, in response to user queries which specify the subset of events for which reduced data is needed. To support this approach we propose to partition the datasets on the cross product of several trigger inputs, instead of storing the data in chronological order. Queries will be automatically decomposed into a set of requests against several partitions. Indexing, physically clustering the data on the logical partitions and caching of partitions will be employed for efficiency.

7775 **Environment for high energy physics code development.** Wisinski, D.E. (Stanford Linear Accelerator Center, CA, USA). *Computer Physics Communications;* 45: No. 1-3, 417-421(Aug 1987). (CONF-870249—).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

As the size and complexity of high energy experiments increase there will be a greater need for better software tools and new programming environments. If these are not commercially available, then we must build them ourselves. This paper describes a prototype programming environment featuring a new type of file system, a "smart" editor, and integrated file management tools. This environment was constructed under the IBM VM/SP operating system. It uses the system interpreter, the system editor and the NOMAD2 relational database management system to create a software "shell" for the programmer. Some extensions to this environment are explored.

7776 **Producing and supporting sharable software.** Johnstad, H.; Nicholls, J. (Fermi National Accelerator Lab., Batavia, IL, USA). *Computer Physics Communications;* **45**: No. 1-3, 473-474(Aug 1987). (CONF-870249—).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

Although software is critical to the success of any high energy experiment, the effort involved in planning and implementation is often under-estimated. The need for sharable software, advanced tools, and enhanced support is assessed. The results of a questionnaire on software issues are presented. One conclusion from this inquiry is that there is a mandate for a regularly-scheduled US forum on software issues in HEP.

7777 **Front-end data processing in the SLD data acquisition system.** Nielsen, B.S. (Stanford Linear Accelerator Center, CA, USA). *Nuclear Instruments and Methods in Physics Research;* **257**: No. 3, 625-631(1 Jul 1987). (CONF-8605164—). Contract AC03-76SF00515.

From 2. topical seminar on perspectives for experimental apparatus at future high energy machines; San Miniato, Italy (5 May 1986).

The data acquisition system for the SLD detector will make extensive use of parallel processing at the front-end level. Fastbus acquisition modules are being built with powerful processing capabilities for calibration, data reduction and further preprocessing of the large amount of analog data handled by each module. This paper describes the readout electronics chain and data preprocessing system adapted for most of the detector channels, exemplified by the central drift chamber waveform digitization and processing system.

7778 **FNAL experiment E-735 at the CO collider intersection.** Kenney, V.P. (Notre Dame, Indiana). pp 482-490 of Proceedings of the 6th topical workshop on proton-antiproton collider physics. Eggert, K.; Faissner, H.; Radermacher, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606286—).

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

An experiment to study < rho/sub T/ > as a function of dn/dy for TOF identified hadrons is being installed at the CO intersection of the FNAL Tevatron collider. The experiment is sensitive up to dn/dy ≃ 25 and < rho/sub T/ > ≃ 1.5 GeV/c.

7779 **Status of the DO Detector.** Marx, M. (State Univ. of NY, Stony Brook, NY). pp 458-473 of Proceedings of the 6th topical workshop on proton-antiproton collider physics. Eggert, K.; Faissner, H.; Radermacher, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606286—).

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

The DO Detector is a second generation detector, being built to study 2 TeV pp-bar collisions at the DO straight section (diametrically opposite the Wilson Hall high rise) at Fermilab. The detector, approved in mid-1983, has attempted in its design to incorporate the experience UA1 and UA2, and to provide a complementary approach to the CDF detector, being commissioned now at BO.

7780 **The CDF level 1 and level 2 trigger system.** Liss, T.M. (The Univ. of Chicago, Chicago, IL). pp 451-467 of Proceedings of the 6th topical workshop on proton-antiproton collider physics. Eggert, K.; Faissner, H.; Radermacher, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606286—).

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

A two level Fastbus based trigger processor for the CDF detector at Fermilab is described. The Level 1 decision is based on the global energy deposition in the calorimeters as well as the presence of muon candidates and stiff tracks in the central drift chamber. The Level 2 decision is driven by the topology of the event, operating on calorimetry clusters, central stiff tracks and muon candidates.

7781 **DO-uranium liquid argon calorimeter.** Weerts, H. (Michigan State Univ., MI). pp 474-481 of Proceedings of the 6th topical workshop on proton-antiproton collider physics. Eggert, K.; Faissner, H.; Radermacher, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606286—).

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

The DO-experiment at the Fermilab Tevatron proton-antiproton collider will emphasize the identification of leptons and jets and in order to do so needs very good 4 $\pi$ hermetic calorimeter coverage. To achieve this uranium and liquid argon were chosen as the passive and active media. This paper describes the results from two test calorimeters built and tested in 1985, which helped in specifying many of the calorimeter parameters such as: absorber thickness, argon-gap size, total calorimeter thickness, etc. The institutions that participated in the construction and running of the devices as well as the analysis of the data are given.

7782 **Performance characteristics of a high-level solid-state personnel dosimetry system in pulsed radiation environments.** Swaja, R.E.; Sims, C.S.; Oyan, R.; Dooley, M.A. (Oak Ridge National Lab., TN, USA; OECD Halden Reactor Project, Halden, NO; Armed Forces Radiobiology Research Inst., Bethesda, MD, USA). *Radiation Protection Dosimetry;* **15**: No. 2, 109-115(1986).

The Health Physics Research Reactor at Oak Ridge National Laboratory was used to evaluate performance characteristics of a high-level, solid-state, personnel dosimetry system developed for the US Army for the rapid measurement of total (gamma plus neutron) radiation doses to soldiers in locations where tactical nuclear weapons could be used. The gamma sensitive element of the dosemeter consists of a silver-activated phosphate glass and the neutron detector is a silicon diode. Areas considered in this evaluation included pre-irradiation dose indication; accuracy and precision of gamma, neutron, and total dose measurements; time dependence; and temperature effects. Study results indicate that for doses above about 0.4 Gy, the system can provide rapid and accurate dose estimates within accuracy limits specified by several international regulatory and standards agencies for criticality accident dosimetry. However, theoretical and observed lower limits of detection for this system are somewhat higher than the 0.25 Gy minimum dose of interest for general accident dosimetry.

7783 **Performance of low pressure tissue-equivalent chambers and a new method for parameterising the dose equivalent.** Eisen, Y.; Brake, R.J.; Vasilik, D.G.; Erkkila, B.H.; Littlejohn, G.J. (Los Alamos National Lab., NM, USA; Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). *Radiation Protection Dosimetry;* **15**: No. 2, 117-130(1986).

The performance of Rossi-type spherical tissue-equivalent chambers with equivalent diameters between 0.5 $\mu$m and 2 $\mu$m was tested experimentally using monoenergetic and polyenergetic neutron sources in the energy region of 10 keV to 14.5 MeV. In agreement with theoretical predictions both chambers failed to provide LET information at low neutron energies. A dose equivalent algorithm was derived that utilises the event distribution but does not attempt to correlate event size with LET. The algorithm was pre-

dicted theoretically and confirmed by experiment. The algorithm that was developed determines the neutron dose equivalent, from the data of the 0.5 μm chamber, to better than +-20% over the energy range of 30 keV to 14.5 MeV. The same algorithm also determines the dose equivalent from the data of the 2 μm chamber to better than +-20% over the energy range of 60 keV to 14.5 MeV. The efficiency of the chambers is 33 counts per μSv, or equivalently about 10 counts $s^{-1}$ per $mSv.h^{-1}$. This efficiency enables the measurement of dose equivalent rates above 1 $mSv.h^{-1}$ for an integration period of 3 s. Integrated dose equivalents can be measured as low as 1 μSv.

7784 **The ALEPH detector.** Mermikides, M. (Dept. of Physics, Univ. of Wisconsin, Madison, WI). pp 191-206 of Proceedings of the 2nd Hellenic School on elementary particle physics. Argyres, E.N.; Zoupanos, G. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8509280—).

From 2. Hellenic school on elementary particle physics; Corfu, Greece (1 Sep 1985).

An overview of the design of ALEPH to study e/sup +/e/sup -/ annihilation phenomena at LEP is presented, with a description of some of the major detector components. Examples are given of how the detector capabilities may be exploited to study some specific physics processes.

7785 **A fast analog photon trigger for Fermilab experiment 705.** Rameika, R.A. pp 111-117 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

An analog cluster finder/transverse energy trigger for the electromagnetic detector of Experiment 705 is described. The trigger selects interactions having one or more energy clusters over preset transverse energy thresholds in less than 100 nanoseconds plus integration time for the analog signal. The capability of making trigger decisions on this time scale makes this scheme particularly suited to the high rate environment of the SSC type collider.

7786 **Electronic trigger for the ASP experiment.** Wilson, R.J. (Stanford Linear Accelerator Center, Stanford, CA 94305). pp 118-130 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—). Contract AC03-76SF00515.

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The ASP electronic trigger is described. The experiment is based on an electromagnetic calorimeter composed of arrays of lead glass blocks, read out with photo-multiplier tubes, surrounding the interaction point at the PEP storage ring. The primary requirement of the trigger system is to be sensitive to low energy ($\approx$ 0.5 GeV and above) photons whilst discriminating against high rate backgrounds at PEP. Analogue summing of the PMT signals and a sequence of programmable digital look-up tables produces a "dead-timeless" trigger for the beam collision rate of 408 kHz.

7787 **Triggers in UA2 and in UA1.** Dorenbosch, J. (NIKHEF-H, Amsterdam). pp 134-151 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The UA2 and UA1 trigger systems are described as they will be used after the upgrade of the CERN SPPS. The luminosity of the collider will increase to 3.10/sup **30/. The bunch spacing is 4 microseconds, comparable to the time available for a second level trigger at the SSC. The first level triggers are very powerful and deliver trigger rates of about 100 Hz. The UA1 second level trigger operates on the final digitizings with a combination of special and general purpose processors. At the highest trigger levels a small farm of processors performs the final reduction.

7788 **The CDF track processor - Prospects for the SSC.** Gladney, L.D.; Lockyer, N.S.; Van Berg, R. (Univ. of Pennsylvania, Philadelphia, PA 19104). pp 152-162 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

This paper describes the CDF fast track-finding processor and discusses the prospects for using this device at the SSC. The primary purpose of the processor is to reduce the muon trigger rate from pion and kaon decays to an acceptable level. This provides an alternative to several meters of magnetized iron. A good tracking device and a fast track-finding processor provide an alternative to the canonical 4 meters of magnetized iron as a way of studying prompt muons at the SSC. Furthermore, the advances expected in custom and semi-custom chips technologies in the next couple of years appear to make the 30etas crossing times at the SSC more tractable than originally thought. This is of course still a difficult and challenging problem and requires more detailed studies. Finally, the authors emphasize the success of such a processor will ultimately depend largely on the ability to do charged particle tracking at the SSC successfully, and this represents the largest uncertainty in this approach.

7789 **Forward spectrometers at the SSC.** Bjorken, J.D. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 363-376 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

Most of SSC phase and a great deal of physics potential is in the forward/backward region (absolute value of $\Theta < 100$ mrad). Comprehensive open-geometry spectrometers are feasible and very cost effective. Examples of such devices are sketched. Because such spectrometers are very long and may operate at higher $\beta$ and longer bunch spacing, they impact now on SSC interaction - region design. The data acquisition load is as heavy as for central detectors, although there may be less emphasis on speed and more emphasis on sophisticated parallel and/or distributed processing for event selection, as well as on high-capacity buffering.

7790 **UA-1 software and computing, experience and projections.** Linglin, D. (LAPP, Annecy). pp 338-358 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

This short paper is an attempt to summarize the computer related features of UA-1 that can be of interest to any future large experiment. Although the computer world is moving very rapidly and situations are not the same, one should emphasize a few points not to be forgotten: they are called networks, graphics, centralized Mass storage, large memory and CPU capacities, ... and last but not least, a good set of well organized, motivated people.

7791 **Muon triggering at small angles.** Green, D. (Fermilab, Batavia, IL). pp 402-408 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

Muon triggering for forward/backward detectors has been studied. The goal is to cover most of the available rapidity range. In particular, tags for diffractive heavy flavor production are considered.

7792 **Comment on the impact of vertex detectors on triggering and data acquisition in the general purpose 4$\pi$ detector.** Bross, A.; Slaughter, J. (Fermilab, Batavia, IL 60510). pp 390-395 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

In this paper the authors consider the impact that standard vertex detector designs for the generic 4$\pi$ detector might have on data acquisition and triggering. The authors take as given the general purpose detector as described in the 1984 Snowmass report and silicon vertex detectors as discussed there and at the workshop on new solid state devices held at Berkeley on Oct. 28, 1985.

7793 **Analog gate circuits for fast trigger applications.** Fortner, M.; Bensinger, J.; Kirsch, L.; Poster, R.; Zografou, P. (Physics Dept., Brandeis Univ., Waltham, MA 02154). pp 106-110 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The authors have built a system of analog gates as a trigger for high energy physics experiments. The trigger is formed within 100 ns with TTL logic and could be sped up by use of ECL components. This trigger is ideal for eliminating a background of low energy cells from consideration in the trigger. At the same time the trigger can use fast information about the event to eliminate other backgrounds from the trigger.

7794 **Lowest level trigger for SSC general purpose detectors.** Franzini, P. (Columbia Univ.). pp 93-105 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

As many other groups have before concluded, the author finds it very promising to be able to deploy a fast, analog trigger capable of reducing the initial interaction rate at the SSC of more than 10/sup 8/ Hz to more manageable levels in the tens of kHz range. While the formidable initial interaction rate and high level of occupancy of a calorimeter might make accurate measurements of the energy deposits difficult, but not impossible, this does not appear to be a problem at the lowest trigger level where unique signatures stand out quite clearly.

7795 **Triggering, data acquisition and computing SSC detector parameters.** Gilchriese, M.G.D. (Cornell Univ., Ithaca, NY 14853). pp 76-78 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The purpose of this brief paper is to present some assumptions about detectors for the Superconducting Super Collider (SSC) that might be useful in studying the triggering, data acquisition and computing problems associated with the detectors. These assumptions were used as input at the Workshop to provide a common basis for the working groups.

7796 **Physics at 10/sup 34/ CM/sup -2/SEC/sup -1/.** Diebold, R. (Dept. of Energy, and Argonne National Lab.). pp 46-50 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

Accelerator and detector operation at a luminosity of 10/sup 34/ cm/sup -2/sec/sup -1/ are briefly discussed. While not all physics can (nor need be) studied at such luminosities, interactions with appropriate and distinctive signatures can be observed even in the presence of many other simultaneous events. The highest luminosities will be needed to reach the highest masses and/or to compensate for loss of rates from small branching ratios. As a rule of thumb, an order-of-magnitude increase in luminosity is a relatively cheap way of achieving the equivalent of a doubling of the beam energy for many processes. In spite of the high rates, the data acquisition and analysis for the detector described here are expected to be easier than for the standard 4$\pi$ detector operating at 10/sup 33/ cm/sup -2/sec/sup -1/.

## 4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

7797 **(AD-A—184672/4/XAB) Dramatically improved radiation hardness for CMOS silicon-gate integrated circuits even down to cryogenic temperatures. Final report.** Alter, M. (Micrel, Inc., Sunnyvale, CA (USA)). 29 Jun 1987. 3p. NTIS, PC A02/MF A01.

This program focuses on Field-Hardness ; specifically, the parasitic N-channel leakages which can result on the edge of an N-channel transistor from source to drain, from drain of one device to the drain of another or from drain (across the CMOS P-well) to the N-substrate (Vdd). This type of leakage normally causes device failure well before the more publicized gage-oxide problem cause Vt to drift out of spec. By butting a poly field plate directly next to the device in the width direction (for example), it was possible to dramatically minimize the positive charge that can build up during irradiation, since there is a minimal amount of oxide under this field plate; this technique is used to extend previously used concepts of using buried $P^+$ guard rings and special gate/field overlap layout to improve the radiation hardness of integrated circuits and has the added bonus of obviously not being sensitive to carrier freeze-out phenomena that degrade $P^+$ guard-ring usefulness at a cryogenic temperatures.

7798 (GA-A—18763, pp 42, Paper 11) **Radiation effects in optical fibers.** Griscom, D.; Friebele, E.J. (Naval Research Lab., Washington, DC). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

The effects of radiation on optical fibers is presented. Topics covered include (1) parameters affecting fiber response, (2) the pos-

sibility that fused silica is an ideal material, (3) the best choice for a structural probe - electron spin resonance; and (4) the extent of radiation induced damage in pure- and doped-silica core fibers.

7799 (GA-A—18763, pp 43, Paper 12) **Optical fibers & cable in adverse environments.** Maklad, M.S. (EOTEC Corp., West Haven, CT). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Optical fibers and cables have significant advantages over other signal transmission media. The signals themselves have a very large bandwidth, thereby permitting numerous channels. Some of the more important advantages are small size, easy installation, no electromagnetic or radiofrequency interference (no EMI or RFI), resistance to radiation damage, no crosstalk between channels, and no ground loop problems.

## 4403 Miscellaneous Instruments

*REFER ALSO TO CITATION(S) 7442, 7443, 7602, 7685, 7686, 7741*

7800 (CONF-870733—13) **A two-dimensional CCD-based system for parallel detection in EELS [Electron Energy Loss Spectroscopy].** Zaluzec, N.J.; Strauss, M.G.; Naday, I.; Sherman, I.S. (Argonne National Lab., IL (USA)). Aug 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002983/JAW.

From Pacific workshop and meeting on analytical electron microscopy; Kona, HI, USA (12 Jul 1987).

A parallel Electron Energy Loss Spectroscopy (EELS) detector system has been developed which is based upon a two-dimensional charge coupled device (CCD) array. Performance data for the prototype system are presented. It is shown that a two-dimensional CCD detector is suitable for use as part of a parallel detector system for EELS. In addition to recording spectra, the device can be operated in an imaging mode, allowing a multifaceted experimental system to be configured from a single detector setup. In spectral acquisition mode, the experimentally measured detective quantum efficiency was 0.4 with a frame-to-frame signal fluctuation of only 0.4%. (LEW)

7801 (ESA-SP—256, pp vp) **Thermoelectronic Radiometer (TER): a new fast response nonintrusive device for radiation and temperature measurement.** Lange, L.; Gilles, J.; Ast, G. Feb 1987. NTIS, PC A99/MF A01; print copy avail. EPD, ESTEC, Noordwijk, The Netherlands Dfl 100. (ETN—87-90484; CONF-8612114—).

From 6. European symposium on material sciences under microgravity conditions; Bordeaux, France (2 Dec 1986).

A device which measures the power of the total incident electromagnetic radiation, i.e., wavelengths from long range infrared to ultraviolet without spectral selectivity was developed. Major characteristics include high sensitivity and very short response time. The contactless operation mode provides promising applications in space technology. Hardware for use in terrestrial research under extreme environmental conditions is presented. The principle of another instrument based on photoelectronics for ultra fast measurement is discussed.

7802 (PNL-SA—15199) **Landsat thematic mapper radiometric calibration study.** Wukelic, G.E.; Gibbons, D.E.; Foote, H.P.; Martucci, L.M. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 7p. (CONF-8709179—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001965/JAW.

From Annual Landsat TM investigators' workshop; Santa Barbara, CA, USA (1 Sep 1987).

The intent was to develop and test analytical techniques that will enhance the scientific and technical exploitation of digital multispectral data. The thrust involved radiometric calibration efforts aimed at determining the bias and validity in absolute temperature determinations using TM band 6 data. Other objectives included: looking at spectral characterization; change detection; combined reflective and emissive data use; and mixed pixel and atmospheric adjustments. To date, six TM data sets (five day scenes and one night scene) have been analyzed. Calibration accuracy of the water and non-water satellite-determined temperatures, using atmospherically corrected radiance values determined from LOWTRAN 6 with local radiosonde, non-local radiosonde, and LOWTRAN 6 model atmospheres, have been studied. Thermal values for non-water pixels have recently been determined. Extensive progress has been made in validating our calibration methodology, analyzing TM5-band 6 data sets for water and non-water pixels, verifying the mixed pixel and atmospheric adjustment methodologies, considering the quantitative effects of clouds and emissivities on absolute temperature determinations, and in conducting initial experiments relative to band 7 calibration.

7803 (SAND—87-2539C) **Measuring thin film properties using SAW [surface acoustic wave] devices: Diffusivity and surface area.** Martin, S.J.; Frye, G.C.; Ricco, A.J.; Zipperian, T.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-8710201—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002216/JAW.

From IEEE ultrasonics symposium; Denver, CO, USA (13 Oct 1987).

Surface acoustic wave (SAW) devices have been used in two new techniques for the characterization of thin film properties. By monitoring the change in surface wave propagation velocity, the sorption of gases and vapors by a film can be recorded. In the first technique, the absorption transient for gas and vapor molecules diffusing into polymer films is observed. These transient data can be fit to a one-dimensional diffusion equation and a diffusivity extracted. In the second technique, the adsorption of nitrogen by a porous film is measured at 77 K as a function of partial pressure. The effective surface area of porous thin films can be extracted from such adsorption isotherms using standard BET analysis. 20 refs., 5 figs.

7804 **Silicon diffraction gratings for multilayer structures.** Ciarlo, D.R.; Miller, D.E. (Electronics Engineering Dept., Lawrence Livermore National Lab., P.O. Box 5504, L-156, Livermore, CA 94550). pp 163-170 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-7405-ENG-48.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Anisotropic etching was used to fabricate diffraction gratings on silicon wafers for use as substrates for layered synthetic multilayers. The author worked with (110) and (100) oriented wafers to achieve etched sidewall angles of 35.3°, 46.5°, 54.7°, and 90°. Contact lithography was used to print gratings with a 20 $\mu$ period in order to evaluated the quality of the etched sidewalls. Projection lithography was used to print gratings with a 2 $\mu$ perioid. Blazed gratings were fabricated from (111) oriented wafers cut 6° off the normal to the growth direction. A crystal alignment technique is described that allowed us to align the gratings to better than 0.1° of the correct crystal direction. Measurements are reported on the smoothness of etched silicon surfaces using three different etches.

7805 **Recent developments with metal-oxide multilayered U.V. mirrors.** Vien, T.K.; Delaboudiniere, J.P.; Lepetre, Y. (Laboratoire de Magnetisme, CNRS, 1, Place Aristide Briand, 92195 Meudon Cedex). pp 129-132 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

In a previous paper on Si-SiO/sub 2/ multilayered mirrors, the authors have shown that metal-oxide systems can be an interesting alternative to metal-metal multilayered coatings for XUV optics in the range from 10 nm to 60 nm. In this paper, they report experimental results of studies made on: a) an Si-SoO/sub 2/ Fabry-Perot etalon; b) an Al-SiO/sub 2/ multilayered mirror; and c) an Al-Al/sub 2/O/sub 3/ multilayered mirror.

7806 **Capability of kinetic ellipsometry as an in situ control system for ultra thin layers stacks growth: Application to the realization of performant soft X-ray optics.** Houdy, P.; Bodart, V.; Nevot, L.; Corno, D.; Pardo, B.; Arbaoui, M.; Alehyane, N.; Barchewitz, R.; Lepetre, Y.; Ziegler, E. (Laboratoires d'Electronique et de Physique Appliquee, 3, avenue Descartes, 94450 Limeil Brevannes). pp 122-128 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Diode RF sputtering techniques has been used to produce carbon tungsten ultra thin layers stacks for application in the soft X-ray domain as optical system. In situ kinetic ellipsometry has been chosen tp control the multilayers growth with a great accuracy. Grazing X-ray reflection (1.54 A), absolute soft X-ray reflectivity (44.7 A) and electron microscopy results confirm a posteriori the ellipsometry capabilities. The stacks have low roughness (2 A) and low periodicity errors (2%), 13% experimental reflectivity instead of 20% theoretical (2 d = 90 A) and 7% instead of 12% (2 d = 60 A) have been obtained.

7807 **Calibrations of a multichannel soft X-ray spectrometer.** Blake, R.L.; Hockaday, R.G.; Grosso, J.S.; Idzorek, G.C.; Henke, B.L.; Wood, J.L. (Los Alamos National Lab., Physics Div., P.O. Box 1663, MS D410, Los Alamos, NM 87545). pp 146-156 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A time resolved, 14 channel spectrometer with an absolutely calibrated response, was developed to cover an x-ray photon energy spectrum from 70 to 650 eV. The spectrometer utilized a combination of thin film prefilters, layered synthetic microstructure (LSM) diffractors, metal coated plastic scintillators, and photomultiplier detector tubes. Calibration of the spectrometer was done piecemeal for each component with standard techniques and the component calibrations were convolved to get a complete spectrometer response function. The complete assembled system was also calibrated at a synchrotron beamline. The two calibration procedures were compared.

7808 **Design and fabrication of heat resistant multilayers.** Thorne, J.M.; Knight, L.V.; Peterson, B.G.; Perkins, R.T.; Gray, K.J. (Departments of Chemistry and Physics, Brigham Young Univ., Provo, UT 84602). pp 139-145 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Many promising applications of multilayer x-ray elements subject them to intense radiation. This paper discusses the selection of optimal pairs of materials to resist heat damage and presents simulations of multilayer performance under extreme heat loadings.

7809 **Design of X-ray optical systems to perform in pulsed, high flux X-ray environments.** Kania, D.R. (Los Alamos National Lab., P.O. Box 1663, Los Alamos, NM 87454). pp 157-162 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Simple analytic and semianalytic models have been developed to estimate the useful lifetime of multilayer x-ray optics in pulsed, high x-ray flux environments. Analytic models are used for the reflectivity and absorption for arbitrary angle of incidence to calculate the absorbed power. The absorbed x-ray flux is converted to a temperature rise via the material enthalpy. Estimates of the effects of energy transport within the multilayer and of various mechanisms, which can effect multilayer performance are discussed.

7810 **Multilayers for X-ray optics: Production by diode sputtering and characterization by microcleavage transmission electron microscopy.** Ziegler, E.; Lepetre, Y.; Fenske, G. (Materials Science Div., Argonne National Lab., Argonne, IL 60439). pp 193-200 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—). Contract W-31-109-ENG-38.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

A multilayer with 99 bi-layers and a 2.5 nm period made of carbon and tungsten has been produced as a test sample for a diode sputtering apparatus and process. The process included Microcleavage Transmission Electron Microscopy as a rapid characterization method.

7811 **X-ray CCD cameras II: A versatile laboratory system.** Luppino, G.A.; Ceglio, N.M.; Doty, J.P.; Ricker, G.R.; Vallerga, J.V. (Dept. of Physics and Center for Space Research, Massachusetts Institute of Technology, Bldg 37 Room 518, 70 Vassar St., Cambridge, MA 02139). pp 222-233 of Multilayer structures and laboratory x-ray laser research. Ceglio, N.M.; Dhez, P. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

The use of charge-coupled devices (CCDs) as single photon X-ray detectors has been documented by several research groups. In this paper the authors described the design and performance of a powerful laboratory instrument for imaging and non-dispersive spectroscopy of soft X-rays (200 eV to 10 keV) utilizing Texas Instruments TI-4849 virtual-phase CCDs. With this instrument they have achieved a spatial resolution of 22 microns (limited by pixel size) with an overall array area of 584 x 390 pixels. They have achieved an energy-resolution of —140 eV FWHM for single-pixel Fe55 X-ray events (5.9 keV) with the CCD operated at only -30°C. They have operated the CCD in photon-counting mode at room-temperature and have obtained X-ray spectra with an energy resolution of —450 eV at 5.9 keV. They also have demonstrated the low-energy X-ray sensitivity of the CCD by detecting Carbon K-alpha X-rays (277 eV).

# 45 EXPLOSIONS AND EXPLOSIVES

## 4501 Chemical

7812 **(CEA-DAS—325) Study on possible explosive reactions of sodium nitrate-bitumen mixtures initiated by a shock wave.** Savornin, J.; Vasseur, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). 1986. 185p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751359/JAW.

Potential hazards of the mixture sodium nitrate-bitumen obtained by embedding in bitumen liquid radioactive effluents concentrated by evaporation are studied in case of accidental shock wave. A theoretical evaluation based on thermodynamical data show a low probability, nevertheless different from zero. No explosion occurred in tests realized in severe conditions. In conclusion there is no risk of detonation of large quantity of bitumen-nitrates stored in 200-liter drum in radioactive waste storage.

## 4502 Nuclear

*REFER ALSO TO CITATION(S) 7687, 8354*

# 50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

## 5001 Basic Studies

7813 **Mean July temperature at 6000 yr B.P. in eastern North America: regression equations for estimates from fossil-pollen data.** Bartlein, P.J.; Webb, T. III. (Brown Univ., Providence, RI). pp 301-342 of Climatic change in Canada 5: critical periods in the quaternary climatic history of northern North America. Harington, C.R. (ed.). Ottawa, Ontario; National Museums of Canada (1985). Contract FG02-85ER60304.

Construction of an isotherm map for eastern North America at 6000 yr B.P. required a set of 13 multiple regression equations that estimate mean July temperature from a linear combination of pollen types. These equations were developed using over 1700 observations of modern pollen data, and then were applied to a network of 211 sites with pollen spectra dated to 6000 yr B.P. The isotherm map shows that mean July temperatures were higher at 6000 yr B.P. than today for a region from central Quebec to the southern United States. This region of higher temperatures narrowed to the west and extended into Saskatchewan. The temperature estimates are much lower than those of today in northern Quebec and Labrador, where a small residual ice sheet still existed at 6000 yr B.P.

## 5002 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 7202, 7213, 7233, 7439, 7441, 7576, 7596, 7598, 7599, 7600, 7601, 7603, 7646, 7742, 7743, 7854, 7866, 7869, 7871*

7814 **(ORNL/TM—10557) Comparison of combustion pollutants from Charania briquettes, consumer barbecue briquettes, Pakistani Mineral Development Corporation briquettes, and Pakistani wood charcoal.** Wilson, D.L.; Hawthorne, A.R. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001864/JAW.

This report presents the results of an experimental comparison of combustion pollutants from Charania briquettes, barbecue briquettes; Pakistani natural wood charcoal; and Pakistani Mineral Development Corporation briquettes (PMDC). This study determined the relative emissions of carbon monoxide (CO), oxides of nitrogen (NO/sub x/), sulfur dioxide ($SO_x$), photoionizable organic compounds (POC) and respirable suspended particulates (RSP) from the combustion of Charania briquettes compared to more traditional fuels. The results obtained in this combustion study indicate that the Charania briquettes are somewhat higher in CO, $SO_2$, and POC than the natural wood charcoal, but are similar in RSP and lower in NO/sub x/ concentrations. In all cases, the peak CO concentrations (~350 mg/m³) generated by these 50 g samples in the room-size test chamber are high compared to various standards (e.g., occupational, ambient air). 4 figs., 8 tabs.

7815 **(PB—87-231254/XAB) Prevention reference manual: chemical specific. Volume 4. Control of accidental releases of ammonia (SCAQMD (South Coast Air Quality Management District)). Final report, August 1986-February 1987.** Davis, D.S.; DeWolf, G.B.; Quass, J.D.; Stohs, M. (Radian Corp., Austin, TX (USA)). Aug 1987. 128p. (DCN—87-203-024-98-23). NTIS, PC A07/MF A01.

See also PB—87-227062.

This manual summarizes technical information that will assist in identifying and (therefore) controlling ammonia-associated release hazards specific to the South Coast Air Quality Management District (SCAQMD), which has considered strategies for reducing the risk of a major accidental air release of toxic chemicals. The strategy includes monitoring the storage, handling, and use of certain chemicals and providing guidance to industry and communities. Ammonia gas has an immediately dangerous to life and health (IDLH) concentration of 500 ppm, which makes it an acute toxic hazard. To reduce the risk associated with an accidental release of ammonia, some of the potential causes of accidental releases that apply to processes using ammonia in the SCAQMD must be identified. Examples of such potential causes are identified, as are measures that may be taken to reduce the accidental risk. These measures include recommendations on: plant design practices; prevention, protection, and mitigation technologies; and operation and maintenance practices. Conceptual costs of possible prevention, protection, and mitigation measures are estimated.

7816 **(PB—87-231262/XAB) Prevention reference manual: chemical specific. Volume 2. Control of accidental releases of ammonia. Final report, November 1986-June 1987.** Davis, D.S.; DeWolf, G.B.; Quass, J.D.; Stohs, M. (Radian Corp., Austin, TX (USA)). Aug 1987. 160p. (DCN—87-203-023-94-15). NTIS, PC A08/MF A01.

See also PB—87-231254.

This report discusses the control of accidental releases of ammonia to the atmosphere. Ammonia has an IDLH (immediately dangerous to life and health) concentration of 500 ppm, making it an acute toxic hazard. Reducing the risk associated with an accidental release of ammonia involves identifying some of the potential causes of accidental releases that apply to process facilities that use ammonia. This manual identifies examples of potential causes and measures that may be taken to reduce the accidental-release risk. Such measures include recommendations on: plant design practices; prevention, protection, and mitigation technologies; and operation and maintenance practices. Conceptual cost estimates of example prevention, protection, and mitigation measures are provided. The accidental release of a toxic chemical at Bhopal, India, in 1984 was a milestone in creating increased public awareness of toxic release problems. As a result of other, perhaps less dramatic, incidents in the past, portions of the chemical industry were aware of the problem long before Bhopal.

7817 **(PB—87-231742/XAB) In-depth survey report of Scoular Elevator, Salina, Kansas.** Zaebst, D.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 43p. (IWS—149.18). NTIS, PC A03/MF A01.

An in/depth industrial hygiene survey of exposures to phosphine during the use of aluminum phosphide was conducted as part of a survey on exposure to grain fumigants. Area monitoring and breathing-zone sampling for phosphine were conducted during the addition of aluminum phosphide to grain during turning operations; source samples and peak personal exposures were also analyzed. Major sources of personal exposure included the escape of air from the bin headspace during filling with treated grain, filling and emptying of the phosphide pellet dispenser, and infiltration from the treated grain bin and from the pellet dispenser itself into adjacent air space. Relatively good dust control was indicated by the total dust samples collected during the survey. Measures recommended by the author are in the report.

7818 **(PB—87-231759/XAB) Design of laboratory systems for controlling the activity of moderately volatile organic compounds.** Westall, J.; Brownawell, B.; Hilburn, R.; Schuytema, G. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Aug 1987. 64p. NTIS, PC A04/MF A01.

The gas-phase transfer of hexachlorobenzene (HCB) from the solid to the chambers used for sediment-water bioaccumulation tests was investigated. The physical properties of HCB found in the literature are summarized. Significant discrepencies were found among different methods. The chief sources in uncertainty in these data were due to variations in temperature, and the possible incomplete equilibration of the solid with the gas. These items are discussed in detail. The theory for transfer from gas to a liquid is developed. The effects of association of HCB with humate and other competing processes (head space losses, adsorption to food, organisms, sediment) are included. Experimental data from the use of the apparatus in actual bioaccumulation experiments are discussed.

7819 **(PB—87-231825/XAB) Environmental characterization and mortality experience of attapulgite clay workers.** Zumwalde, R.D.; Ness, G.O.; Waxweiler, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). 23 Oct 1980. 35p. NTIS, PC A03/MF A01.

A retrospective cohort study of attapulgite clay mill and mine workers at Engelhard Minerals and Chemicals Corporation was carried out, and environmental samples were collected and analyzed. All men who worked for at least 1 month during 1940 through 1975 at the facility made up the cohort. General air samples, personal breathing-zone air samples, and settled dust samples were analyzed for free silica and trace metals. Particulates were subjected to electron microscope characterization. Iron was the only trace metal found in any appreciable quantity. The main constituent of samples was attapulgite clay.

7820 **(PB—87-232203/XAB) Method for estimating fugitive particulate emissions from hazardous-waste sites. Final report, April-September 1984.** Turner, J.H.; Branscome, M.R.; Chessin, R.L.; Damle, A.S.; Kameth, R.V. (Research Triangle Inst., Research Triangle Park, NC (USA)). Aug 1987. 192p. NTIS, PC A09/MF A01.

Control techniques are reviewed for applicability to fugitive particulate emissions from hazardous-waste sites. Techniques judged applicable include chemical stabilization (40 to 100% efficiency, $520/acre-yr to $2,720/acre-yr), wet suppression (25 to 90% efficiency, $365/acre-yr to $1,270/acre-yr), physical covering (30 to 100% efficiency, $0.01/sq.m to $65/sq.m), vegetative covering (50 to 80% efficiency, $0.11 /sq.m to $3.96/sq.m), and windscreens (30 to 80% efficiency, $18.01/sq.m to $26.90/sq.m of screen). Reducing vehicle speed on unpaved roads can reduce emissions by 25 to 80% depending on initial conditions. Supporting reviews are included for soil characteristics, emission factors, and dispersion processes that generate and distribute fugitive particulate matter. A method is described to estimate degree of contamination (DOC) of soil particles based on the contaminating chemical's water solubility and the soil's organic carbon content. A first-order decay process is included. Five example sites are described and estimates made of uncontrolled and controlled downwind concentrations of hazardous constituents. Annual averages are in the attogram to nanogram per cubic meter range. Ranges for control and efficiency costs for each site are included.

7821 **(PB—88-100052/XAB) Total exposure assessment methodology (TEAM) study.** (Environmental Protection Agency, Washington, DC (USA). Office of Acid Deposition, Environmental Monitoring, and Quality Assurance). Jun 1987. 2302p. NTIS, PC E99.

Set includes PB—88-100060 through PB—88-100094.

7822 **(PB—88-100060/XAB) Total exposure assessment methodology (TEAM) study: summary and analysis. Volume 1.** Wallace, L.A. (Environmental Protection Agency, Washington, DC (USA). Office of Acid Deposition, Environmental Monitoring, and Quality Assurance). Jun 1987. 209p. (EPA—600/6-87/002A). NTIS, PC A10/MF A01.

See also Volume 2, PB—88-100078; Also available in set of 4 reports PC E99, PB—88-100052.

The TEAM Study measured exposures to 20-25 volatile organic compounds in the air, drinking water, and exhaled breath of 650 persons in 4 states. Volume I is a summary and overview of the entire study. Volume II deals with studies in New Jersey, North Carolina, and North Dakota. Volume III deals with studies in California. Volume IV presents the Standard Operations Procedures employed in the study. Major findings include: (1) personal monitors and breath spirometers employing Tenax adsorbents are sensitive and adequately precise instruments to determine normal daily exposures of the general public; (2) personal and indoor exposures generally exceeded outdoor concentrations; (3) major sources of exposure include occupations, smoking, visiting dry cleaners, and filling gas tanks.

7823 **(PB—88-100078/XAB) Total exposure assessment methodology (TEAM) study: Elizabeth and Bayonne, New Jersey, Devils Lake, North Dakota and Greensboro, North Carolina. Volume 2, parts 1 and 2. Final report.** Pellizzari, E.D.; Perritt, K.; Hartwell, T.D.; Michael, L.C.; Sparacino, C.M. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jun 1987. 899p. NTIS, PC A99/MF E04.

See also Volume 1, PB—88-100060, and Volume 3, PB—88-100086; Also available in set of 4 reports PC E99, PB—88-100052.

The TEAM Study measured exposures to 20-25 volatile organic compounds in the air, drinking water, and exhaled breath of 650 persons in 4 states. Volume I is a summary and overview of the entire study. Volume II deals with studies in New Jersey, North Carolina, and North Dakota. Volume III deals with studies in California. Volume IV presents the Standard Operations Procedures employed in the study. Major findings include: (1) personal monitors and breath spirometers employing Tenax adsorbents are sensitive and adequately precise instruments to determine normal daily exposures of the general public; (2) personal and indoor exposures generally exceeded outdoor concentrations; (3) major sources of exposure include occupations, smoking, visiting dry cleaners, and filling gas tanks.

7824 **(PB—88-100086/XAB) Total exposure assessment methodology (TEAM) study: selected communities in northern and southern California. Volume 3. Final report.** Pellizzari, E.D.; Perritt, K.; Hartwell, T.D.; Michael, L.C.; Whitmore, R. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jun 1987. 523p. (RTI—2391/00-03F). NTIS, PC A22/MF A01.

See also Volume 2, PB—88-100078, and Volume 4, PB—88-100094; Also available in set of 4 reports PC E99, PB—88-100052.

The TEAM Study measured exposures to 20-25 volatile organic compounds in the air, drinking water, and exhaled breath of 650 persons in 4 states. Volume I is a summary and overview of the entire study. Volume II deals with studies in New Jersey, North Carolina, and North Dakota. Volume III deals with studies in California. Volume IV presents the Standard Operations Procedures employed in the study. Major findings include: (1) personal monitors and breath spirometers employing Tenax adsorbents are sensitive and adequately precise instruments to determine normal daily exposures of the general public; (2) personal and indoor exposures generally exceeded outdoor concentrations; (3) major sources of exposure include occupations, smoking, visiting dry cleaners, and filling gas tanks.

7825 **(PB—88-100094/XAB) Total exposure assessment methodology (TEAM) study: standard operating procedures employed in support of an exposure assessment study. Volume 4.** Handy, R.W.; Smith, D.J.; Castillo, N.P.; Sparacino, C.M.; Thomas, K. (Research Triangle Inst., Research Triangle Park, NC (USA)). Jun 1987. 671p. NTIS, PC A99/MF A01.

See also Volume 3, PB—88-100086; Also available in set of 4 reports PC E99, PB—88-100052.

The TEAM Study measured exposures to 20-25 volatile organic compounds in the air, drinking water, and exhaled breath of 650 persons in 4 states. Volume I is a summary and overview of the entire study. Volume II deals with studies in New Jersey, North Carolina, and North Dakota. Volume III deals with studies in California. Volume IV presents the Standard Operations Procedures employed in the study. Major findings include: (1) personal monitors and breath spirometers employing Tenax adsorbents are sensitive and adequately precise instruments to determine normal daily exposures of the general public; (2) personal and indoor exposures generally exceeded outdoor concentrations; (3) major sources of exposure include occupations, smoking, visiting dry cleaners, and filling gas tanks.

7826 **(PB—88-100128/XAB) Type B technical information document: application of air models to natural resource injury assessment.** McNaughton, D.J. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Jun 1987. 90p. NTIS, PC A05/MF A01.

See also PB—88-100136; Also available in set of 5 reports PC E99, PB—88-100110.

This document provides information on the selection of simulation models that can be used with 43 CFR Part 11 regulations for type B natural resource damage assessments. Techniques are presented for the estimation of emissions, dispersion, or chemical transformations in the atmosphere in terms of concentration, dose, or deposition amounts. Also summarized are various types of models that are available and the expected uncertainty or limitations in their respective use. The document describes potential approaches to using models as assessment tools, describes the types of data usually required, and discusses sources of modeling data to be used if the incident report does not provide adequate data coverage. The document provides information for the selection of an appropriate model for simulations, describes models as candidates for use in assessments, and provides references. The information in the document supplements the guidance provided in 43 CFR Part 11, but is not required to be followed to obtain the rebuttable presumption provided by those regulations.

7827 **(PB—88-100789/XAB) Aerosol optical depth and ratios of diffuse-sky to total solar irradiance measured from aircraft following the eruption of El Chichon. Data report.** Dutton, E.G.; DeLuisi, J.J. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jun 1987. 37p. (NOAA-DR-ERL-ARL—12). NTIS, PC A03/MF A01.

Spectral aerosol optical depth and relative measurements of diffuse and total solar irradiance fields were made from an aircraft flying in the upper troposphere following the April 1982 eruption of El Chichon. Two series of flights were flown, one in December 1982-January 1983 and the other in May 1983. The optical-depth measurements reveal the latitudinal distribution of the stratospheric volcanic debris between 50°N and 6°S latitude for December-January and 72°N and 56°S for May. The ratios of the downward diffuse to the downward total solar irradiance and albedo at aircraft altitude are given for times determined to be cloud-free above the aircraft. The report describes the acquisition of and access to the data obtained on the flights, and presents edited results in summary graphical and tabular form.

7828 **(PB—88-101142/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 6, wire reclamation incinerator WRI-A.** Keller, L.E.; McReynolds, J.R.; Benson, D.J. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 211p. (RAD—87-222-109-02-22). NTIS, PC A10/MF A01.

See also PB—88-101159, and PB—86-232857.

This report summarizes the results of a dioxin/furan emissions test of a wire-reclamation incinerator equipped with an afterburner for hydrocarbon emissions control. The wire reclamation incinerator is used for recovery of copper from coated copper wire and drained transformer cores. The test was the sixth in a series of several dioxin/furan emissions tests conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions. Wire reclamation incinerators are one of 8 combustion-source categories that have been tested in the Tier 4 program. The tested incinerator WRI-A was selected for the test after an initial information screening and a one-day pretest survey visit. Incinerator WRI-A is considered representative of the wire-reclamation incinerator population in the United States. Data presented in the report include dioxin (tetra through octa homologue + 2378 TCDD) and furan (tetra through octa homologue + 2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7829 **(PB—88-101159/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 77, wood-fired boiler WFB-A.** Keller, L.E.; Keating, M.H.; Jamgochian, C.L. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 298p. (RAD—87-222-109-02-23). NTIS, PC A13/MF A01.

See also PB—88-101142, and PB—88-101167; Portions of this document are not fully legible.

This report summarizes the results of a dioxin/furan emissions test of a wood-fired boiler equipped with a fabric-filter system for particulate emissions control. The boiler combusts a combination of bark, hogged wood, sawdust, and green and dry planar shavings. The test is the seventh in a series of emission tests conducted under Tier 4 of the National Dioxin Study. The primary objective of tier 4 is to determine if various combustion devices are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions. Wood-fired boilers are one of eight combustion-device categories that have been tested in the Tier 4 program. The tested boiler, WFB-A, was selected for this test after an initial information screening and a 1-day pretest survey. The logs processed at the plant are stored in a salt-water body adjacent to the plant. Thus, the feed to Boiler WFB-A has a higher inorganic chloride content than the feed to most wood-fired boilers. Boiler WFB-A is considered representative of those wood-fired boilers in the United States firing salt-laden wood. Data presented in the report include dioxin (tetra through octa homologue +2378 TCDD) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7830 **(PB—88-101167/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 8, Black-liquor boiler BLB-C.** Jamgochian, C.L.; Keller, L.E. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 202p. (RAD—87-222-109-02-24). NTIS, PC A10/MF A01.

See also PB—88-101159, and PB—88-101175.

This report summarizes the results of a dioxin/furan emissions test of a black-liquor recovery boiler equipped with a dry-bottom electrostatic precipitator for particulate emissions control. Black-liquor recovery boilers are used at kraft pulp mills to produce process steam and to reclaim inorganic chemicals from spent wood pulping liquors. The dioxin/furan emissions test was conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions. Black-liquor recovery boilers are one of 8 combustion-source categories that have been tested in the Tier 4 program. The tested black-liquor boiler, BLB-C, was selected for the test after an initial information screening and a one-day pretest survey visit. Boiler BLB-C is considered representative of black-liquor recovery boilers with dry-bottom electrostatic precipitators. The amount of chloride present in the black-liquor circuit at this site is considered intermediate to high relative to that found at other kraft pulp mills. Data presented in the report include dioxin (tetra through octa homologue +2378 TCDD) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7831 **(PB—88-101175/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 9, carbon-regeneration furnace CRF-A.** Jamgochian, C.L.; Keller, L.E.; Kelly, W. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 271p. (RAD—87-231-056-12-43). NTIS, PC A12.

See also PB—88-101167, and PB—88-101183; Portions of this document are not fully legible.

The Environmental Protection Agency is assessing the potential for the emissions of dioxin/furans from combustion sources under Tier 4 of the National Dioxin Study. If any of the combustion sources are found to emit dioxins, the secondary purpose of the Tier 4 study is to quantify these emissions and, if possible, related the emissions to combustion parameters. Carbon-regeneration furnaces are 1 of 8 source categories that have been included in the field test program. Carbon-regeneration furnaces reactivate spent carbon from industrial or municipal water-treatment facilities. The spent carbon may contain absorbed chlorinated compounds. The report presents the results of an emission-test program conducted by Radian during May 28-31, 1985, at an industrial carbon-regeneration furnace designated as Site CRF-A. The furnace was selected after an initial information screening and a pretest survey visit. The facility is considered representative of other carbon-regeneration furnaces in the United States. Furnace CRF-A regenerates spent carbon from more than 20 plants that use activated carbon

for industrial wastewater treatment. Data presented in the report include dioxin (tetra through octa homologue +2378 TCDF) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7832 **(PB—88-101183/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 10, secondary-copper-recovery cupola furnace MET-A.** Keller, L.E.; McReynolds, J.R.; Benson, D.J. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 181p. (RAD—87-231-056-12-44). NTIS, PC A09/MF A01.

See also PB—88-101175, and PB—88-101191.

This report summarizes the results of a dioxin/furan emissions test of a secondary-copper-recovery cupola furnace equipped with an afterburner for hydrocarbon emissions control and two baghouses for particulate-emissions control. The cupola furnace is used for recovery of copper from telephone scrap and other copper-bearing materials. The test was No. 10 in a series of dioxin/furan emissions tests conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions. Secondary-copper-recovery cupola furnaces are one of 8 combustion-source categories that have been tested in the Tier 4 program. The tested cupola furnace, MET-A, was selected for the test after an initial information screening and a one-day pretest survey visit. Cupola furnace MET-A is a large secondary-copper-recovery cupola furnace relative to others in the United States. The furnace feed includes plastic-bearing materials of various types, some of which may contain chlorinated organic compounds. Data presented in the report include dioxin (tera through octa homologue +2378 TCDD) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7833 **(PB—88-101191/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 11, drum and barrel reclamation furnace DBR-A.** Knisley, D.R.; Kelly, W.E.; Keller, L.E. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 190p. (RAD—87-231-056-12-47). NTIS, PC A09/MF A01.

See also PB—88-101183, and PB—88-101209.

This report summarizes the results of a dioxin/furan emissions test of a drum and barrel reconditioning furnace equipped with an afterburner for emissions control. Steel drums are reconditioned by combusting the drum contents (residual material) in a tunnel furnace. The test was the 11th in a series of emission tests conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion devices are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions. Drum-reconditioning furnaces are one of 8 combustion-device categories that have been tested in the Tier 4 program. The tested furnace, DBR-A, was selected for the test after an initial information screening and a one-day pretest survey. The drums processed at the plant are received from a number of different sources, thus the combustible material burned in the furnace is heterogeneous. Furnace DBR-A is considered representative of other drum-reconditioning furnaces operating in the United States. Data presented in the report include dioxin (tetra through octa homologue +2378 TCDD) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7834 **(PB—88-101209/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 12, sewage sludge incinerator SSI-C.** Palazzolo, M.A.; Bath, D.B.; Jamgochian, C.L.; Benson, D.D. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 143p. (RAD—87-231-056-12-48). NTIS, PC A07.

See also PB—88-101191, and PB—88-101217; Portions of this document are not fully legible.

This draft report summarizes the results of a dioxin/furan emissions test of a sewage-sludge incinerator equipped with a wet-scrubber system for particulate-emissions control. The test was the 12th in a series of thirteen dioxin/furan emissions tests being conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources emit dioxins or furans. The secondary objective of Tier 4 is to quantify these emissions. Sewage-sludge incinerators are one of eight combustion-device categories that have been tested in the Tier 4 program. The tested sewage-sludge incinerator, SSI-C, was selected for the test after an initial information screening and a one-day pretest survey visit. Data presented in the report include dioxin (tetra through octa homologue + 2378 TCDD) and furan (tetra through octa homologue +2378 TCDF) results for both stack samples and ash samples. In addition, process data collected during sampling are also presented.

7835 **(PB—88-101217/XAB) National Dioxin Study Tier 4 - combustion sources: final test report - Site 13, residential wood stove WS-A.** Hartman, M.W.; Benson, D.J.; Keller, L.E. (Radian Corp., Research Triangle Park, NC (USA)). Apr 1987. 67p. (RAD—87-222-109-02-25). NTIS, PC A04/MF A01.

See also PB—88-101209.

This report summarizes the results of a dioxin/furan emission test of a residential woodstove conducted by Radian Corporation. The stove is a freestanding noncatalytic model manufactured by Atlanta Stove Works and offered for sale in the Sear's Catalog. During testing, oak and pine were burned at low burn rates, which is representative of normal residential use. The test was the 13th in a series of dioxin/furan emissions tests conducted under Tier 4 of the National Dioxin Study. The primary objective is to determine if various combustion sources are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions. Residential woodstoves are among 8 combustion-source categories that have been tested in the Tier 4 program. The tested woodstove, hereafter referred to as Woodstove WS-A, is a test unit located at an EPA contractor facility. This stove was selected for inclusion in the Tier 4 program due to its location in the RTP area and because simultaneous testing of the stove was already being conducted for another EPA program (Integrated Air Cancer Project). The woodstove tested is considered representative of woodstoves built in the last 5 to 10 years. No dioxin/furan stack data were obtained from the source. Labelled internal standards used to determine analytical recovery efficiency were not detected because of the very high levels of hydrocarbons present in the stack gas. Dioxin/furan ash data are presented.

7836 **(PB—88-101464/XAB) Condensation nuclei and aerosol-scattering extinction measurements at Mauna Loa Observatory: 1974-1985. Data report.** Massey, D.M.; Quakenbush, T.K.; Bodhaine, B.A. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jul 1987. 169p. (NOAA-DR-ERL-ARL—14). NTIS, PC A08/MF A01.

The observatory at Mauna Loa, Hawaii measures the characteristics of surface aerosols under background conditions. The instruments provide data that are representative of the background-aerosol climatology at Mauna Loa. These data can also be used to identify potential local contamination periods. The nephelometer's light-scattering measurements show an annual cycle: a maximum in April and a minimum in November, with a variation of a factor of 5.5. The Condensation Nucleus (CN) counter shows a much smaller annual cycle: a maximum in September and a minimum in March, with a variation of a factor of 1.5. A local decrease in CN concentration occurs in August. The Angstrom exponent minimum occurs in May. This indicates larger aerosol particles within the month as compared with the remainder of the year.

7837 **(PB—88-101761/XAB) Topical report on a field-monitoring study of homes with unvented gas space heaters. Volume 1. Preliminary research plan. Final report, August-September 1984.** Nagda, N.L.; Koontz, M.D. (GEOMET Technologies, Inc., Germantown, MD (USA)). Sep 1984. 21p. (GEOMET-ER—1489). NTIS, PC A03/MF A01.

See also Volume 2, PB—88-101779.

The report describes a preliminary research plan for an indoor-air-quality monitoring study of homes with unvented gas space heaters (UVGSHs). The objectives of the field-monitoring study are to determine the concentration ranges of carbon monoxide (CO) and nitrogen dioxide ($NO_2$) in such residences and to determine patterns of UVGSH usage in these homes. A three-tiered monitoring strategy is planned. The most-comprehensive monitoring package (type A) will feature continuous measurements for $NO_2$, CO, relative humidity, and temperature over 4 to 6 days in about 10% of study homes. A moderate monitoring package (type B) will consist of continuous measurements for CO, relative humidity, and temperature in 20% of the homes. In the remaining homes, the least comprehensive package (type C) will have passive measurements for CO and $NO_2$ and indicators of maximum/minimum temperature. Passive measurements for $NO_2$ concentrations and air exchange rates will also be included in the type A and B packages. An initial estimate of the number of homes to be monitored is 176. The sampling strategy will focus on urban areas in northern Texas and southern Oklahoma. In the chosen neighborhoods, a brief canvassing effort will be conducted to identify and recruit specific homes with UVGSHs. Participating residences will be administered a questionnaire and will be asked to maintain activity logs during monitoring. Formal monitoring was to begin in January 1985 and continue until mid-March.

**7838 (PB—88-101779/XAB) Topical report on a field-monitoring study of homes with unvented gas space heaters. Volume 2. Protocol for sample selection and measurements. Final report, October 1984-January 1985.** Koontz, M.D.; Fortmann, R.C.; Nagda, N.L. (GEOMET Technologies, Inc., Germantown, MD (USA)). Jan 1985. 108p. (GEOMET-IE—1654). NTIS, PC A06/MF A01.

See also Volume 1, PB—88-101761.

The report describes the protocol used for an indoor-air-quality monitoring study of homes with unvented gas space heaters (UVGSHs). The objectives of the field-monitoring study are to determine the concentration ranges of carbon monoxide (CO) and nitrogen dioxide ($NO_2$) in such residences and to determine patterns of UVGSH usage in these homes. The protocol addresses the following items: Methods of selecting residences to be surveyed and monitored; Monitoring strategy including three types of monitoring packages; Procedures for deploying monitoring instruments in residences and documentation; Procedures for instrument calibrations and sample analyses; Methods for handling and transforming field data and samples; Quality assurance and quality-control provisions. Approximately 176 homes in northern Texas and southern Oklahoma were to be monitored. Three types of monitoring packages were to be used: A, most comprehensive monitoring package to be used in 10% of homes, B, intermediate-level monitoring package to be deployed in 20% of homes, and C, simplest monitoring package, to be used in all of the homes. Two sites were to be monitored in each home and monitoring conducted over 4 to 6 days during January through March 1985.

**7839 (PB—88-102108/XAB) Use of back air trajectories in interpreting atmospheric-chemistry data: a review and bibliography. Technical memo.** Miller, J.M. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jun 1987. 34p. (NOAA-TM-ERL-ARL—155). NTIS, PC A03/MF A01.

One of the most-important aspects of atmospheric chemistry is interpreting the measurements of different chemical species in terms of their cycles in the earth-atmosphere system. One method - calculation of single, back trajectories from the point of measurement - was widely and successfully employed to evaluate transport of chemical substances in the atmosphere. The paper reviews how the single-trajectory analysis has been applied in atmospheric chemistry. It surveys the different models used, the methods of application, and the forms in which the results are presented. Despite its limitations, the single, back-trajectory analysis method has proved very useful in the interpretation of atmospheric-chemistry data.

**7840 (PB—88-102876/XAB) Quantifying uncertainty in long-range transport models: workshop report on sources and evaluation of uncertainty in long-range transport models.** Demerjian, K.L. (American Meteorological Society, Boston, MA). 1986. 206p. NTIS, PC A10/MF A01.

See also report dated Sep 1984, PB—87-196101.

The quantification of uncertainty in long-range transport model predictions and the implications of these uncertainties on formulations of control policy have been the subject of investigations by both the United States and Canada. To more fully address these topics, the American Meteorological Society (AMS) was requested to convene a workshop in September 1984 at the National Academy of Sciences Study Center in Woods Hole, Massachusetts. Joint sponsorship was provided by the U.S. Environmental Protection Agency, the Ontario Ministry of the Environment, Canada, and the Atmospheric Environment Service of Environment Canada. The AMS workshop was three and one-half days in duration and involved participation by 38 scientists from the United States, Canada, and Europe. Five invited draft chapters were prepared prior to the workshop to provide a focus for discussion, i.e., to raise the pertinent scientific issues to be addressed by the participants. This AMS publication contains the complete documentation of the workshop including the five invited chapters, recent developments in model evaluation and sensitivity analysis, and the reports of the Eulerian and Lagrangian working groups.

**7841 (PB—88-103007/XAB) Regional field-study design for evaluation of Eulerian acidic deposition models.** Hansen, D.A.; Lusis, M.; Barnes, H.M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Sep 1987. 14p. (EPA—600/D-87/268). NTIS, PC A03/MF A01.

The U.S. Environmental Protection Agency and the Electric Power Research Institute, the Ontario Ministry of the Environment, and the Atmospheric Environmental Services have funded the development of two complex regional-scale Eulerian acid-deposition models, RADM and ADOM. There is a consensus among the scientific community that the models should be evaluated as to their skill in predicting output parameters and to establish their credibility. This paper describes the measurements planned in a large field study to provide data for this evaluation. The plan is divided into two parts: operational and diagnostic. The operational evaluation assesses the models' ability to predict air concentrations and deposition patterns. The diagnostic evaluation is an assessment of the behavior of the model and its individual components, transport, dry deposition, gas-phase chemistry, emission inventory, etc. Plans for an extensive network of ground-sampling stations and intensive aircraft measurements over a two-year period are discussed.

**7842 (PB—88-103015/XAB) Characterization of particle and organic emissions from unvented kerosene space heaters. Report for September 1986-February 1987.** White, J.B.; Leaderer, B.P.; Boone, P.M.; Hammond, S.K. (Yale Univ., New Haven, CT (USA). School of Medicine). Sep 1987. 9p. NTIS, PC A02/MF A01.

This paper gives results from Phase I of a three-phase study to characterize and model contaminant emissions from unvented kerosene space heaters. In Phase I (a screening phase), emissions from 12 heaters, covering a range of design types and Btu ratings, were evaluated during start-up at three steady-state operating conditions (normal, low, and high flame settings), and after shutdown. Aerosol mass, size distribution, extractable mass, bioassay, trace-element content, and conventional gas (CO, NOx, etc.) measurements were made for all the heaters tested, while volatile and semivolatile organics measurements were made for a subsample.

**7843 (PB—88-104237/XAB) Comparison of three methods for measurement of atmospheric nitric acid and aerosol nitrate and ammonium.** Anlauf, K.G.; Fellin, P.; Wiebe, H.A.; Schiff, H.I.; Mackay, G.I. (Atmospheric Environment Service, Downsview, Ontario (Canada)). 1985. 11p. NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 19, No. 2, 325-333(1985).

Three methods for measuring gaseous ambient nitric acid in the low-concentration range 0-15 mcg/cum were compared under field conditions in southwestern Ontario during June 1-14, 1982. The methods employed were (1) tunable diode laser absorption, (2) a tungstic acid denuder tube, and (3) a filter pack containing a Teflon-nylon-W41 filter combination operated over 3-hour sampling periods. In general, the three methods measured nitric acid

with adequate sensitivity (sub ppb) and they correlated reasonably over the low ambient concentrations considered here. However, there were some notable differences (up to a factor of 2 at night) by the tungstic acid and filter-pack methods. These correlated well, but again some differences were observed. During the field comparison, particulate nitrate and ammonium were also measured (0-6 mcg/cu m range) by the tungstic acid and filter-pack methods. These correlated well, but again some differences were observed.

7844 **(PB—88-104245/XAB) Decline of red spruce in the Adirondacks, New York.** Scott, J.T.; Siccama, T.G.; Johnson, A.H.; Breisch, A.R. (North Carolina State Univ., Raleigh (USA)). 1984. 9p. NTIS, PC A02/MF A01.

Pub. in Bulletin of the Torrey Botannical Club, Vol. 111, No. 4, 438-444(Oct-Dec 1984).

Thirty-two stands in the spruce-fir forests of Whiteface Mountain in the Adirondacks, originally sampled from 1964-66, were resurveyed in 1982. From 10-25 Bitterlich points were used in each stand in 1982 to obtain an estimate of basal area per hectare. Data were summarized for low elevation (<900m) and high elevation (> or = 900m) forests. Red spruce declined by 40-60% in basal area for the low elevation forests and by 60-70% above 900m. Balsam fir decreased by 35% at high elevations, due to natural disturbance in several of the stands, but was unchanged when only undisturbed stands were considered. The decline of red spruce accounted for about three quarters of the total decrease in basal area for both the high- and low-elevation forests. Spruce seedling frequency for the high-elevation sample decreased by 80%, but was unchanged below 900m. The pattern of spruce decline in the Adirondacks is similar to findings for New England. The cause of the decline is speculative at the time.

7845 **(PB—88-104278/XAB) Joint action of $O_3$ and $SO_2$ in modifying plant gas exchange.** Olszyk, D.M.; Tingey, D.T. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). 1986. 7p. (EPA—600/J-86/394). NTIS, PC A02/MF A01.

Pub. in Plant Physiology, Vol. 82, 401-405(1986).

The joint action of $O_3$ and $SO_2$ stress on plants was investigated. Gas exchange measurements of $O_3$, $SO_2$, and $H_2O$ vapor were made for garden pea. Plants were grown under controlled environments; $O_3$, $SO_2$, $H_2O$ vapor fluxes were evaluated with a whole-plant gas exchange chamber using the mass-balance approach. Maximum $O_3$ and $SO_2$ fluxes per unit area into leaves averaged 8 nanomoles per square meter per second with exposure to either $O_3$ or $SO_2$ at 0.1 microliters per liter. Internal fluxes of either $O_3$ or $SO_2$ were reduced by up to 50% during exposure to combined versus individual pollutants; the greatest reduction occurred with simultaneous versus sequential combinations of the pollutants. Stomatal conductance to $H_2O$ was substantially altered by the pollutant exposures, with $O_3$ molecules twice as effective as $SO_2$ molecules in inducing stomatal closure. Stomatal conductance was related to the integrated dose of pollutants. When $O_3$ was present at the start of the exposure, then stomatal response resembled that for $O_3$ more than the response for $SO_2$. The study indicated that stomatal responses with combinations of $O_3$ and $SO_2$ are not dependent solely on the integrated dose of pollutants, but suggests that a metabolic synergistic effect exists.

7846 **(PB—88-104294/XAB) Effects of acidic rain and ozone on nitrogen fixation and photosynthesis in the lichen lobaria pulmonaria (L.) Hoffm.** Sigal, L.L.; Johnston, J.W. (Oak Ridge National Lab., TN (USA). Environmental Sciences Div.). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in Environmental and Experimental Botany, Vol. 26, No. 1, 59-64(Jan-Mar 1986).

The lichen Lobaria pulmonaria was subjected to ozone fumigations at 118, 235 and 353 mcg/cu m and simulated acidic rain at pH levels of 2.6, 4.2 and 5.6 for 5 days (M,W,F,M,W) during a 10-day period. Acidic rain at pH 2.6 caused significant reduction in nitrogen fixation and gross photosynthesis of 100 and 90%, respectively, and thallus bleaching was apparent. There were no significant differences between the pH 5.6 and 4.2 treatments in either gross photosynthesis or nitrogen fixation, and the color of the lichen thalli was unchanged. The effect of ozone on nitrogen fixation and photosynthesis over the range of concentrations used was not significant, but there was a trend toward reduced nitrogen fixation with increasing $O_3$ concentration. There were no significant ozone-acidic rain interactions. The threshold for response to rain acidity for L. pulmonaria lies between pH 2.6 and 4.2, and the acidity of wet deposition in parts of the United States may fall in the range.

7847 **Oxidant measurements at remote continental and marine coastal sites in the western United States.** Gaffney, J.S.; Mroz, E.; Finnegan, D.; Hall, J.H. (Los Alamos National Lab., Los Alamos, NM). pp 560 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Organic oxidants and aldehydes of particular interest to these researchers are the organoperoxy nitrates (as well as analog organic nitrates), organic peroxides and peracides, formaldehyde, acetaldehyde and higher aldehydes. Chemical modeling efforts will be used to estimate atmospheric levels of peracetic acid (PAA) and methylhydroperoxide (MHP) based upon actual field data for peroxyacetyl nitrate (PAN), aldehydes, and more routine analyses for NO/sub x/ and ozone. Source characterization for these species is planned using carbon-14 isotopic determinations which should allow the relative contributions from biomass and fossil sources for organic oxidants and aldehydes to be determined. Measurements of ozone and peroxyacetyl nitrate (PAN) have been initiated at two remote stations in the western United States. The two sampling sites have been chosen to examine the effects of altitude (solar flux and albedo), relative humidity, temperature and meteorological conditions on the production of oxidants and their precursors. Data obtained for ozone, PAN, and other oxides of nitrogen for approximately eight months are presented for the New Mexico site, and preliminary data for coastal site discussed with regard to diurnal and seasonal variability. Particular attention is paid to the implications of these data with regard to potential levels of organic oxidants in remote areas. The possibility of these species playing roles in forest ecosystem impacts is proposed as an area for future research.

7848 **Oxidant production in remote atmospheres: Modeling clean and perturbed situations.** Streit, G.E.; Gaffney, J.S. (Los Alamos National Lab., Los Alamos, NM). pp 563 of Proceedings of the symposia of the division of environmental chemistry of the American Chemical Society. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

There is a growing awareness that oxidants and organic toxins, both by themselves and in concert with atmospheric acids, play an important role in ecosystem effects such as forest decline. There is thus a definite need to understand the mechanisms and rates of oxidant production in natural (clean) atmospheres and the changes in those mechanisms and rates as anthropogenic perturbations begin to increase. Approximately eight months of ambient ozone, peroxyacetylnitrate (PAN), and oxides of nitrogen (NO/sub x/) data have been collected at a remote continental site in northern New Mexico (35.9°N) near Los Alamos National Laboratory. This site can be characterized as dry (avg. RH 30-40%), high elevation (1.95 km), and sunny (>80% of available sunshine). This data provides a base from which to assess the roles of diurnal and seasonal cycles, air mass origin, and other photochemical parameters such as surface albedo on ambient oxidant levels. These detailed actinic flux calculations are used in combination with a clean air tropospheric box model and the Los Alamos field data to determine the necessary ambient levels of natural or anthropogenic hydrocarbons which lead to observed levels of oxidants. The model is also used in a predictive mode to determine (on a seasonal basis) the magnitude of increases in hydrocarbons and nitrogen oxides which could lead to unacceptable ambient levels of oxidant.

## 5003 Radioactive Materials Monitoring And Transport

7849 **(PB—88-106315/XAB) Review of selected state-of-the-art applications of diagnostic measurements for radon-mitigation planning. Report for April 1986-June 1987.** Hubbard, L.M.; Harrje, D.T.; Gadsby, K.J.; Sanchez, D.C.; Turk, B.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). Sep 1987. 10p. (EPA—600/D-87/245). NTIS, PC A02/MF A01.

Since late-1984, EPA's AEERL has supported a program to develop and demonstrate radon-mitigation techniques for single-family detached dwellings. As part of the program, projects have been started, directed at developing and demonstrating the use of diagnostic measurements in all phases of the radon-mitigation process. Diagnostic measurements are used to assess: (1) the radon sources strengths, variability, and locations; and, (2) radon transport to the house and its entry and distribution in the house as influenced by environmental, house characteristics, and occupancy factors. The diagnostic measurements reported include: (1) soil-gas grab sampling; (2) communication (air flow or pressure-field extension) tests; (3) whole house infiltration; (4) differential pressure, (5) gamma radiation; and, (6) radon flux. The paper concludes that the above selected diagnostic measurements were especially useful in characterizing houses with indoor radon problems attributable to soil-gas-borne radon that may be amenable to mitigation through the use of subslab ventilation.

## 5004 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 7719*

## 5006 Regulations

*REFER ALSO TO CITATION(S) 7551, 7553, 7554, 7826*

7850 **(PB—88-100110/XAB) Type B technical information documents: set of five.** (Department of the Interior, Washington, DC (USA)). Jun 1987. 557p. NTIS, PC E99/MF E99.

Set includes PB—88-100128 through PB—88-100169.

This set of five documents provides technical information associated with the 43 CFR Part 11 regulations for type B natural resource damage assessments. The first document of the set discusses the use of models to describe movement of oil or hazardous substances in air and the application of air models to assess injury. The second document concerns the assessment of injury to soil, and includes possible methods for determining injury and procedures for quantifying the effects of injury to soil. The third document discusses injury to fish and wildlife species, providing details on the types of injury and testing procedures that may be used to document injury to fish and wildlife species. The fourth document pertains to the use of Habitat Evaluation Procedures and Suitability Index Models for use in quantifying habitat changes resulting from a discharge or release. The last document of the set describes techniques to measure damages, provides a discussion of economic methodologies that may be applied in the determination of monetary damages, and discusses the acceptance criterion for selection of economic methodologies. The information in these documents supplements the guidance provided in 43 CFR Part 11, but is not required to be followed to obtain the rebuttable presumption provided by those regulations.

7851 **(PB—88-100342/XAB) Rubber-tire-manufacturing industry - background information for promulgated standards. Environmental impact statement (Final).** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Sep 1987. 51p. (EPA—450/3-81/008B). NTIS, PC A04/MF A01.

See also PB—83-163543.

Standards of performance for the control of volatile organic compounds (VOC) emissions from rubber-tire-manufacturing facilities are being promulgated under Section 111 of the Clean Air Act. These standards will apply to newly constructed, modified, or reconstructed facilities in rubber-tire-manufacturing plants. The document summarizes the public comments received on the proposed standards and the Agency's responses to those comments. The document also summarizes the changes made to the standards since proposal.

7852 **(PB—88-100359/XAB) Guideline on exceptions to data requirements for determining attainment of particulate matter standards.** Pollack, A.K.; Thrall, A.D. (Systems Applications, Inc., San Rafael, CA (USA)). Apr 1987. 23p. NTIS, PC A03/MF A01.

See also PB—86-245248.

This guideline document describes procedures that can be used to demonstrate attainment of the particulate-matter standards for those sites that do not satisfy the minimum data requirements. In order to apply these procedures, minimum quarterly data requirements must be met. The procedures involve the substitution of appropriate data for the missing samples; collocated TSP can be substituted for missing PM 10 samples, and substitutions from available monitoring data are also allowed. Under certain conditions, model-derived estimates of annual means and number of exceedances may also be used. Four examples demonstrate the use of the procedures under various scenarios.

# 51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

## 5101 Basic Studies

*REFER ALSO TO CITATION(S) 7802*

## 5102 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 7163, 7167, 7168, 7556, 7593, 7820, 7848, 7864, 7865, 7870, 7914*

7853 **(PB—88-102397/XAB) Analysis of modified wet-air oxidation for soil detoxification.** Unterberg, W.; Willms, R.S.; Balinsky, A.M.; Reible, D.D.; Wetzel, D.M. (Environmental Monitoring and Services, Inc., Camarillo, CA (USA)). Sep 1987. 33p. NTIS, PC A03/MF A01.

This report presents the results of research on wet-air oxidation as a method for the destruction of hazardous wastes. For organics in the presence of large amounts of water, the water need not be vaporized during wet-air oxidation, an attractive characteristic for energy conservation. The feasibility of using wet-air oxidation was investigated in terms of the effects of temperature, pressure, and the presence or absence of soil on the oxidation rate of three model compounds. Wet-air oxidation is a semi-commercial process that has been used to treat a variety of weakly toxic chemical wastes and for the regeneration of activated carbon. In the study, wet-air oxidation research was carried out in a 1-liter batch reactor at temperatures from 130 to 275°C and pressures from 703-1760 x $10^3$ kg/sq m on three substances: m-xylene, tetrachloroethylene (TCE), and malathion, both with and without addition of soil. Any attempt to balance the effect of residence time and the cost of energy requires an accurate description of the oxidation kinetics for the compound or waste stream in question. Due to the sampling technique used during the investigation and the inherent nature of the wet-air oxidation process, a variety of potential problems with the interpretation and analysis of the raw concentration-time data were encountered during the study.

7854 **(PB—88-103627/XAB) pH buffering in forest-soil organic horizons: relevance to acid precipitation.** James, B.R.; Riha, S.J. (Cornell Univ., Ithaca, NY (USA). Dept. of Agronomy). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Environmental Quality, Vol. 15, No. 3, 229-234(1986).

Samples of organic surface horizons (Oi, Oe, Oa) from New York State forest soils were equilibrated with 0 to 20 cmol $HNO_3$ Kg(-1) soil in the laboratory by a batch technique designed to simulate reactions of acid precipitation with forest floors. Each organic

horizon retained a constant percentage of added H(1+)(67-96%) regardless of quantity added and buffer capacities of the samples ranged from 18 to 36 cmol (H+)kg-1(pH unit) (-1), an order of magnitude higher than those measured in underlying mineral horizons. Calcium was the dominant cation in unacidified equilibrium solutions, and its concentration changed the most in response to acidification of the soils. Aluminum contributed <1% to total cationic charge in solution and Fe concentration decreased upon addition of up to at least 5 cmol (H+)kg-1. From 38 to 79% of $H^+$ removed by the soils was not balanced by increased in soluble Ca, Mg, K, Mn, Fe, Zn, Al, and Cu, and buffering by soluble organic and inorganic constituents accounted for 8 to 58% of $H^+$ removal.

## 5103 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 7281, 7289, 7467*

7855 **(LA—11146-M) High resolution, in situ, gamma-ray spectrometry procedures manual.** Sautter, C.A. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002741/JAW.

Procedures used for environmental in situ gamma-ray spectroscopy of the Los Alamos National Laboratory are documented. These procedures are based on techniques developed at other laboratories, principally by H.L. Beck et al., of the Department of Energy's Environmental Measurements Laboratory. The procedures are limited to use of large-volume, lithium-drifted or high-purity germanium diode detectors for quantification of the contributions of specific radionuclides to external exposure rate as well as their concentrations in and on the ground. This manual includes general background information and detailed "how to" step-by-step procedures with illustrative examples employing these techniques.

7856 **Trace cobalt sorption on 21 sediment types from the Hanford Site, Washington.** Routson, R.C.; Barney, G.S.; Delegard, C.H.; Smith, R.M. (Rockwell Hanford Operations, Richland, WA 99352). *Nuclear and Chemical Waste Management;* 7: No. 2, 73-88(1987).

Studies were conducted at the Hanford Site in Washington State to measure the 200 East and 200 West Separation Areas' sorption properties for trace cobalt (/sup 60/Co). Scintillation logs of ground disposal facilities and particle size plus calcium carbonate sediment data were used to independently delineate sediment types. Good agreement was found between the sediment types delineated by the two methods. Twenty-one sediment types were delineated from five wells. Twenty-one empirical distribution coefficient (Kd) equations were developed for trace /sup 60/Co sorption of 21 sediment types from the Hanford Site 200 Separation Areas. The coefficients in these equations for /sup 60/Co were internally of the same general form. However, there were marked differences between comparable coefficients. Average coefficient values were computed for /sup 60/Co and compared with individual sediment type coefficients. Cobalt sorption was controlled only by calcium (Ca/sup +2/). These data are required for the transport modeling of /sup 60/Co in varied sodium, calcium, and potassium soil-water systems.

7857 **Speciation of /sup 99/Tc and /sup 60/Co: Correlation of laboratory and field observations.** Bondietti, E.A.; Garten, C.T. (Environmental Sciences Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 79-92 of Speciation of fission and activation products in the environment. Bulman, R.A.; Cooper, J.R. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-850473—). Contract AC05-84OR21400.

From Seminar on the speciation of fission and activation products in the environment; Oxford, UK (16 Apr 1985).

The speciation of /sup 99/Tc and /sup 60/Co in groundwater and soils contaminated with leachates from retired waste-disposal trenches is discussed. The behavior of /sup 99/Tc in soil is a complex interaction between soil-associated, reduced species of Tc and the very soluble Tc0/sub 4-bar/ anion. An association between reduced Tc species and soil organic matter is evident. Humic substances solubilized with a chelating resin contained about 8% of the soil Tc, with most of it bound in a nondialyzable form except when NaOCl was present. Added /sup 95/m/sub -/Tc0/sub 4-bar/ did not adsorb to this humic material. Density-gradient separations also confirmed the presence of a light (organic) soil fraction enriched in Tc. An anion exchange resin equilibration indicated that about 20% of the bound Tc came into solution (oxidized) at a rate of 0.015 d/sup -1/ under conditions favoring oxidation. The species of /sup 60/Co in contaminated groundwater is discussed in the context of a review of past work.

## 5104 Thermal Effluents Monitoring And Transport

7858 **Effects of atmospheric CO/sub 2/ enrichment on plant growth: the interactive role of air temperature.** Idso, S.B.; Kimball, B.A.; Anderson, M.G.; Mauney, J.R. (U.S. Water Conservation Lab., Phoenix, AZ). *Agriculture, Ecosystems and Environment;* 20: No. 1, 1-10(Nov 1987).

Comprehensive reviews of the plant science literature indicate that a 300 part per million (ppm) increase in atmospheric carbon dioxide (CO/sub 2/) concentration generally increases plant growth by approximately 30%. Working with two species of floating aquatic plants and three terrestrial species, it is demonstrated that this stimulatory effect of atmospheric CO/sub 2/ enrichment is strongly temperature dependent. Indeed, the results suggest that for a 3 C increase in mean surface air temperature (as is generally predicted to result from the 'greenhouse effect' of such an increase in the CO/sub 2/ content of the air), the growth enhancement factor for such a CO/sub 2/ increase rises from 1.30 to 1.56. If the non-CO/sub 2/ trace gas greenhouse effect is equally as strong, as recent model studies suggest, the growth enhancement factor rises still higher to a value of 1.85. On the other hand, the results also indicate that atmospheric CO/sub 2/ enrichment tends to reduce plant growth at relatively cold air temperatures, i.e. below a daily mean air temperature of approximately 18.5 C. As a result, predicting the ultimate biospheric consequences of a doubling of the Earth's atmospheric CO/sub 2/ concentration may prove to be much more complex than originally anticipated.

## 5105 Site Resource And Use Studies

*REFER ALSO TO CITATION(S) 7164, 7165, 7182*

## 5106 Regulations

*REFER ALSO TO CITATION(S) 7184, 7553, 7554, 7850, 7888, 7890, 7891, 7892, 7893*

7859 **(PB—88-100151/XAB) Type B technical information document: guidance on use of Habitat Evaluation Procedures and Habitat Suitability Index models for CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) applications.** (National Ecology Center, Fort Collins, CO (USA)). Jun 1987. 46p. NTIS, PC A03/MF A01.

See also PB—88-100144, and PB—88-100169; Also available in set of 5 reports PC E99, PB—88-100110.

The document provides recommendations on the use of Habitat Evaluation Procedures (HEP) and Habitat Suitability Index (HSI) models for type B natural resource damage assessments within the 43 CFR Part 11 regulations. It provides information to assist in quantifying habitat changes resulting from a discharge of oil or a release of hazardous substances. In the quantification section of that rule, provision is made for measuring the effects of injury, and consequently the damages, due to oil or hazardous substances based on restoration of services lost. The procedures described here are among a number of alternative methods for determining the extent of such injury. It provides recommendations concerning one of several alternative methods of quantifying the effects of injury based on habitat changes. Sources of information for oil and hazardous substances, including data bases and guidance on selecting specialists for assistance with habitat evaluation studies, are discussed. The document also discusses possible applications of HEP in the development of restoration plans. The information in the document supplements the guidance in 43 CFR Part 11, but is not required to be followed to obtain the rebuttable presumption provided by those regulations.

7860 **(PB—88-106497/XAB) Superfund Record of Decision (EPA Region 6): Mid-South Wood Products, Polk County, Arkansas, November 1986. First remedial action. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 14 Nov 1986. 85p. (EPA/ROD/R—06-87/015). NTIS, PC A05/MF A01.

Errata sheet inserted; Portions of this document are not fully legible.

The Mid-South Wood Products site is located in Polk County, Arkansas, approximately 1/2 mile southwest of Mena, Arkansas. The 57-acre site includes the following areas: the Old Plant site, the Small Old Pond and Old Pond areas, the North and South Landfarms, the landfill, Clear Lake and an existing chromated copper arsenate (CCA) treatment plant. The Old Plant site was used to treat wood with pentachlorophenol (PCP) and creosote; the Small Old Pond was the original impoundment for waste PCP and creosote. These two areas have been covered with soil. The Old Pond area was used to store PCP and creosote sludge and has since been graded and covered with soil; materials from the Old Pond were spread over the Landfarm areas and mixed into the soil; the Landfill area contains deposits of sawdust, woodchips, and other waste-wood products; Clear Lake receives runoff from all the above areas; the CCA treatment plant contains an ongoing wood-treating operation where the surface drainage from the plant is put in sumps.

7861 **(PB—88-106505/XAB) Superfund Record of Decision (EPA Region 6): Bayou Sorrel, Louisiana, November 1986. First remedial action. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 14 Nov 1986. 65p. (EPA/ROD/R—06-87/016). NTIS, PC A04/MF A01.

The Bayou Sorrel site is located in Iberville Parish, Louisiana approximately 20 miles southwest of Baton Rouge, LA. Fifty acres of the 265-acre site have been used for waste disposal. The waste-disposal areas consist of four landfills: a spent-lime cell, a crushed-drum cell, four covered liquid-waste ponds, and a land farm. The remaining acres are covered by dense brush and trees. The entire site has a marshy, bayou-type environment and is prone to flooding and poor drainage. Early in 1977, the Environmental Purification Advancement Corporation (EPAC) began operating the Bayou Sorrel site. A sister firm, Clean Land Air Water, Inc. (CLAW) operated an injection well approximately six miles south of the site. EPAC operations included landfarming, open liquid impoundments, drum burial, and landfilling of chemically fixated wastes. The fixation process is unknown but may have included lime, cement, and native soils. EPAC and CLAW were two separate operations, however, it was suggested that wastes from the injection well were diverted to EPAC when process problems at the well caused a bottleneck. In the summer of 1978, a truck driver died at the site.

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## 5201 Basic Studies

*REFER ALSO TO CITATION(S) 7216, 7802*

7862 **(GSF—3/87) Groundwater conversion areas in chalk in the southern Frankish Alps.** Pfaff, T. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Radiohydrometrie; Muenchen Univ. (Germany, F.R.). Fachbereich Geowissenschaften). 1987. 135p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751273/JAW.

In order to collect hydro-geological data, chalk water marking was done and/or interpreted, water balances were produced, the contents tritium, oxygen 18, calcium, magnesium and the groundwater temperatures and electrolytic conductivity of the groundwater were examined and the dry weather drainage of individual sources was analysed.

## 5202 Chemicals Monitoring And Transport

*REFER ALSO TO CITATION(S) 7191, 7556, 7593, 7821, 7822, 7823, 7824, 7825, 7831, 7853, 7854, 7914*

7863 **(LA—11095-MS) A comparison of trace level concentrations for silver, arsenic, barium, cadmium, and lead in drinking waters obtained by inductively coupled plasma-mass spectrometry and electrothermal-vaporization atomic absorption spectroscopy.** Robinson, R.; Bell, M.; Burns, C.; Knab, D. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001629/JAW.

We compared the data obtained by inductively coupled plasma-mass spectrometry (ICP-MS) and electrothermal-vaporization atomic absorption spectroscopy (ETVAA), for concentration values of silver, arsenic, barium, cadmium, and lead in drinking water specimens, spiked analyte recoveries, and control samples. Our goal was to obtain Environmental Protection Agency approval for the ICP-MS as an alternate analytical technique. We obtained similar concentrations for those metals in the natural waters by both methods. Several of the spike recoveries and control sample recoveries, however, varied significantly. Those recoveries indicated a greater level of confidence for the arsenic and barium analytical data obtained using the ICP-MS method. In addition, ICP-MS has rapid multielement analytical technique capabilities with limits of quantification and data confidence comparable to those of ETVAA. Those multielement capabilities and the relative ease of obtaining data make ICP-MS the preferred analytical technique. 5 refs., 8 tabs.

7864 **(PB—88-100607/XAB) Final environmental impact statement and proposed coastal resources management program for the Commonwealth of the Northern Mariana Islands - 1980.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 1980. 352p. (OCRM—87-9). NTIS, PC A16/MF A01.

The Commonwealth of the Northern Mariana Islands has submitted its Coastal Resources Management Program to the Office of Coastal Zone Management for approval. The document includes a copy of the program (Part Two) which is a comprehensive management program for coastal land- and water-use activities. It consists of a number of policies on diverse management issues enforced by various Commonwealth laws, and is the culmination of several years of program development.

7865 **(PB—88-100615/XAB) Puerto Rico coastal management program and final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 1978. 359p. (OCRM—87-10). NTIS, PC A16/MF A01.

Contents include: Introduction - Prepared by the federal office of coastal zone management; The Puerto Rico coastal management program - prepared by the commonwealth; Chapter 1, The coast of Puerto Rico: An overview; Chapter 2, Coastal management for Puerto Rico: overall objectives and policies; Chapter 3, Coastal management for Puerto Rico: problems and responses; Chapter 4, The coastal management program: principal elements; and Environmental impacts - prepared by federal office of coastal zone management.

7866 **(PB—88-101548/XAB) Book review of fundamentals of aquatic toxicology: methods and applications.** Cairns, M.A. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). 1985. 3p. (EPA—600/J-85/502). NTIS, PC A02/MF A01.

Pub. in Transactions of the American Fisheries Society, Vol. 114, No. 6, 917-918(Nov 1985).

The book reviews the field of aquatic toxicology, a rapidly evolving science. On the down side, little or no emphasis was placed on topics such as toxic sediments, nonpoint-source pollution, acid precipitation, or hazardous wastes. In general, though, the volume is a welcome addition to the shelves of graduate schools, researchers, applied scientists, and technical administrators.

7867 **(PB—88-102728/XAB) Toxicity and fate of total residual chlorine in outdoor experimental streams.** Hermanutz, R.O.; Allen, K.N.; Hedtke, S.F. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Sep 1987. 31p. (EPA—600/D-87/284). NTIS, PC A03/MF A01.

Bluegills, channel catfish, white suckers, and rainbow trout were exposed, for several weeks, to various water concentrations of chlorine and chlorine-ammonia mixtures during the summers of 1985 and 1986. The tests were conducted in one-quarter-mile-long experimental streams located along the Mississippi River near Monticello, Minnesota. All streams were continuously supplied with river water. In the 1985 study, streams were treated with chlorine and in the 1986 study, streams were treated with chlorine or a combination of chlorine and ammonia. For both years, chlorine toxicity to the fish was determined by survival and growth effects as related to the water concentration of total residual chlorine (TRC). TRC concentrations in the chlorine treatments were substantially less toxic than in the chlorine-ammonia treatments. Downstream degradation rates of TRC differed between the chlorine and the chlorine-ammonia treatment streams. TRC diel fluctuations at a given sampling site also differed between the two types of treatments. The chlorine streams followed a predictable pattern, whereas the fluctuations in the chlorine-ammonia streams appeared to be random.

7868 **(PB—88-104286/XAB) Comparison of continuous and episodic exposure to acidic, aluminum-contaminated waters of brook trout (Salvelinus fontinalis).** Siddens, L.K.; Seim, W.K.; Curtis, L.R.; Chapman, G.A. (Oregon State Univ., Corvallis (USA). Oak Creek Lab. of Biology). 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Canadian Jnl. of Fisheries and Aquatic Sciences, Vol. 43, 2036-2040(1986).

This study demonstrated that repetitive, intermittent exposures to aluminum (Al) under acidic conditions produced greater cumulative mortality and lower growth rates of brook trout than would be extrapolated from continuous exposure experiments. During a 24-d study, exposures were at pH 4.4 or 4.9 with 0.2-1.2 mg Al-L-1. Data were analyzed based on peak and 24-d mean Al concentrations of continuous and intermittent (2-d toxicant, 4-d ambient condition cycle) exposures. Survival was lower in groups exposed at pH 4.9 than those at 4.4 when intermittently exposed but not when continuously exposed. Growth rates were less for fish continuously exposed at pH 4.4 compared with those at pH 4.9, while intermittent exposures to Al acidity alone did not affect growth. Fish intermittently exposed to Al at pH 4.4 grew faster than those at pH 4.9, indicating greater Al toxicity at the higher pH. (Copyright (c) Canadian Journal of Fisheries and Aquatic Sciences, Vol. 43, 1986.)

7869 **(PB—88-104302/XAB) Total alkalinity of surface waters: a map of the western region.** Omernik, J.M.; Griffith, G.E. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). 1986. 7p. (EPA—600/J-86/410). NTIS, PC A02/MF A01.

Pub. in Jnl. of Soil and Water Conservation, Vol. 41, No. 6, 375-378(Nov-Dec 1986).

The map of total alkalinity of surface waters in the western region illustrates the general patterns of the relative potential sensitivity of surface waters to acidic deposition. As with geology and physiography, surface-water alkalinity in the West varies widely. Most all low-alkalinity lakes and streams occur in the glaciated, high-elevation alpine and sub-alpine zones of the numerous mountain ranges. These watersheds are small with steep slopes and thin acidic soils. The lowest-alkalinity waters are associated most often with granitic and gneissic rock types, but may also be found in volcanic and certain sedimentary areas. Alkalinity concentrations are generally greater in surface waters at lower elevations and often are extremely high in the intermountain valleys, basins, and plateau areas.

7870 **(PB—88-104690/XAB) Fiscal year 1986 program report: Rhode Island Water Resources Research Center.** Poon, C.P.C. (Rhode Island Univ., Kingston (USA). Water Resources Center). Jul 1987. 38p. NTIS, PC A03/MF A01.

See also report for FY 1985, PB—87-159406.

Water resources projects included a detailed partitioning of nitrogen in soil solution, turf clipping, and soil organic for various fertilizer rates; a better method of managing lawn turf to minimize nitrate contamination of ground water was found. Extensive studies showed chloride concentration for river baseflows in Rhode Island lower than the current EPA standards and advisory limits. Both road density and the subsoil layer under the highway in swamp areas were found to affect the chloride concentration. A numerical model of two-phase (gasoline/groundwater) immiscible fluid flow through soil was developed to predict gasoline movement in aquifer and for optimizing the pumping rates in a clean-up process. Effects of alum coagulant dosage, mixing intensity, and mixing time on direct water filtration performance and its optimization in sand filters were investigated.

7871 **(PB—88-106356/XAB) Predicting spring lake chemistry from fall samples.** Newell, A.D. (Northrop Services, Inc., Corvallis, OR (USA)). Sep 1987. 10p. NTIS, PC A02/MF A01.

See also PB—87-110383.

The relationship between fall and spring lake chemistry was investigated for five chemical variables of 103 lakes in seven regions of the United States. Strong linear relationships were found between preceding springs and fall values for acid neutralizing capacity (ANC), pH, sulfate, and calcium. These relationships indicate that sampling a large number of lakes during fall overturn, combined with intensive sampling of representative lakes throughout the year, may be a feasible method of estimating changes in chemistry across a geographic region.

7872 **(PB—88-106398/XAB) Treatment of aqueous metal- and cyanide-bearing hazardous wastes.** Grosse, D.W. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Sep 1987. 8p. (EPA—600/D-87/253). NTIS, PC A02/MF A01.

See also report dated Mar 1987, PB—87-167060.

With the reauthorization of the Resource Conservation and Recovery Act (RCRA) and the concurrent restrictions on land disposal of hazardous wastes, the U.S. Environmental Protection Agency is assessing technologies that can be substituted for, or precursors to land disposal. This paper describes the research work being conducted at the EPA's Test and Evaluation Facility concerning treatment of metal-finishing hazardous wastewater. A series of various technological units have been designed and fabricated to determine the optimum combination of the units for the best treatment of any given wastes. These units are: Alkaline Chlorination of Cyanide, Chromium Reduction, Neutralization/Precipitation, Flocculation and Settling, Mixed-Media Filtration, Activated Carbon Adsorption, and Ion Exchange. Plans for future work utilizing additional technological units is also presented. Results of this work will be used to assess alternative treatment technologies for aqueous metal- and cyanide-bearing hazardous wastes.

7873 **Solubilization of cresols by 1-hexadecylpyridinium chloride micelles and removal of cresols from aqueous streams by micellar-enhanced ultrafiltration.** Bhat, S.N.; Smith, G.A.; Tucker, E.E.; Christian, S.D.; Scamehorn, J.F.; Smith, W. (Dept. of Chemistry, North Eastern Hill Univ., Shillong 793003). *Industrial and Engineering Chemistry Research;* **26**: No. 6, 1217-1221(Jun 1987).

In micellar-enhanced ultrafiltration (MEUF), solubilization of organic solutes in micelles, combined with ultrafiltration of these micellar solutions, leads to the removal of dissolved, low molecular weight organic compounds from water. The permeate from MEUF contains the organic solute at concentrations equal to the unsolubilized solute concentration in the rejected (retentate) solution. Therefore, the equilibrium solubilization of the solute dictates the permeate purity or rejection of the solute by the membrane. The semiequilibrium dialysis method has been used to investigate the equilibrium solubilization of o-, m-, and p-cresol by aqueous solutions of 1-hexadecylpyridinium chloride, throughout a range of concentrations of the cresols and the surfactant. The apparent solubilization constant, K = X/sub c//(concentration of unsolubilized cresol), has been correlated with X/sub c/, the mole fraction of cresol in the micelle.

## 5203 Radioactive Materials Monitoring And Transport

*REFER ALSO TO CITATION(S) 7279, 7285, 7857, 7889*

**7874 (EUR—10825) In situ radionuclide migration studies in a shallow sand aquifer. Part. 1. Part. 2: appendices.** Williams, G.M.; Alexander, L.S.; Hitchman, S.P.; Hooker, P.J.; Noy, D.J.; Ross, C.A.M.; Stuart, A.; West, J.M. (British Geological Survey, Keyworth, UK). (Commission of the European Communities, Luxembourg). 1986. 189p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700794/JAW.

As a result of a study of the geology of the British Nuclear Fuels premises at Drigg, Cumbria, the British Geological Survey identified a shallow glacial sand deposit approximately 1.5m thick, interbedded between two clay horizons. An array of boreholes has been constructed in this sand in order to study the migration of radionuclides introduced into the formation under controlled conditions of groundwater flow. Conservative tracers used in the field test include chloride (as NaCl) and iodine-131 (as NaI). Strontium-85 (as the chloride) has been used as a chemically reactive tracer in conjunction with /sup 131/I. The principal research objectives of the programme are as follows: (1) To undertake laboratory batch sorption experiments using core material from the field site in order to choose those nuclides of radiological interest that would migrate sufficiently quickly for their behaviour to be studied in a field experiment within a reasonable time period. (2) To identify and quantify the mechanisms for nuclide/sediment interaction by determination of the geochemical distribution of /sup 85/Sr in contaminated cores using a sequential leaching procedure. (3) To obtain appropriate data on the hydraulic characteristics of the sand formation in order to construct a mathematical model to describe groundwater flow and reactive mass transport. Part 2 of this report contains the following appendices: (1) Calculation of sorption parameters. (2) A low-cost manifold system for use with multi-level samplers. (3) Radioactivity curves for /sup 131/I and /sup 85/Sr. (4) Results of particle size analysis for sand aquifers.

**7875 (IAEA-R—3295-F) Biogeochemical cycle of mercury species in the marine environment. Final report for the period 1 May 1986 - 30 March 1987.** Branica, M. (Institut Rudjer Boskovic, Zagreb, Yugoslavia). (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700798/JAW.

Mercury contamination of the coastal marine environment is an important concern as highly toxic methyl-mercury may be formed biogenically in sediments rich in organic matter. The present study was conducted using a highly sensitive adaptation of Cold Vapour Atomic Absorption Spectrophotometry (CVAAS) in which mercury was re-mineralised from a variety of marine matrices (water, sediments and organisms), separated and concentrated by ion-exchange chromatography, trapped as an amalgam in gold wool and subsequently re-released by heating to 900 deg. C. Total and organomercury forms were detected respectively by measuring, in the case of seawater, sample extracts treated and untreated with uv light and, in the case of solid matrices, by "total digestion" and 6M HCl extractions. Detection limits were 0.1 ng/1 from a 200 ml water sample and 0.2 μg/kg for a lg solid sample. Water, sediments and organisms were collected by scuba diving from the unpolluted Sibenik aquatorium (including the Krka river estuary), Yugoslavia, and the polluted Kastela Bay, which receives discharge from a chlor-alkali plant. Mercury levels were low in the Sibenik aquatorium (0.34-2.4 ng/dm/sup 3/ water, 78-1522 μg/kg sediments and 24-39 μg/kg w.w. in mussels). Organo-mercury was generally below detection limits in water and represented below 0.5% of the total Hg in sediments but 13-88% of the mercury in mussels and fish. In the Kastela Bay, up to 90 ng/dm/sup 3/ (water), 11870 μg/kg w.w. (mussels) and 48600 μg kg w.w. (oysters) of Hg was detected. Fortunately methyl-mercury was below 0.5% of this total in all matrices. Hg levels in mussels decreased to 41.3 μg/kg w.w. at 600 m from the source. Further research will now be conducted on the biogeochemical cycle of Hg in estuarine and marine environments, with special attention being paid to the fresh/saline water interface. 9 refs, 2 figs, 5 tabs.

**7876 (JAERI-M—87-142) Role of soil characteristics on analysis of water flow in shallow land.** Tohaya, Takayuki; Wakabayashi, Noriaki; Wadachi, Yoshiki. (Tobishima Corp., Tokyo, Japan). (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 21p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751454/JAW.

Analysis of water flow on posutulated model grounds has been carried out by using 2-dimensional finite element analytical model, to clarify the effects of soil characteristics (hydroulic conductivities in saturated and unsaturated zones, moisture content - water head relationship, porosity, etc.) of a shallow land layer on variations in water tables and water flow rates. Results thus obtained indicate that hydroulic conductivities in saturated and unsaturated zones play an important role in governing the development of a water table, especially the hydroulic conductivity of the top layer and of the layers near the water table give significant effect on the water table development. It was found through multiple regression analyses of the variation of the water table that among soil characteristics following parameters give pronounced effect on the development of the water table in the order; the relationship between moisture content of the unsaturated zone and pressure head, the distance between the water table and ground surface, and the saturated hydroulic conductivity of the layer immediately above the water table.

**7877 (PB—88-103064/XAB) Uptake of uranium from drinking water.** Singh, N.P.; Wrenn, M.E. (Utah Univ., Salt Lake City (USA)). Sep 1987. 14p. NTIS, PC A03/MF A01.

The gastrointestinal absorption (G.I.) of uranium in man from drinking water was determined by measuring urinary and fecal excretion of $^{234}U$ and $^{238}U$ in eight subjects. In order to establish their normal backgrounds of uranium intake and excretion, the subjects collected 24 hour total output of both urine and feces for seven days prior to drinking water. During the next day they drank, at their normal rate of drinking water intake, 900 ml of water containing approximately 90 pCi $^{238}U$ and 90 pCi $^{234}U$ (273 meg U) and continued to collect their urine and feces for seven additional days. The G.I. absorption of $^{234}U$ ranged from -0.07% to 1.88% and G.I. absorption of $^{238}U$ ranged from -0.07% to 1.79%. Employing another technique for analyzing the data, the G.I. absorption ranged from -0.04 to 1.46% for $^{234}U$ and from 0.03% to 1.43% for $^{238}U$. The dietary intake of U was also estimated from measurements of urinary and fecal excretion of U in eight subjects prior to drinking water containing U. The estimated average dietary intake of U for these subjects is 3.30 + or - 0.65 or 4.22 + or - 0.65 mcg/day. These averages are two to four times higher than the values reported in the literature for dietary intake.

**7878 Profiles of dissolved and particulate thorium isotopes in the water column of coastal Southern California.** Huh, C.A.; Beasley, T.M. (Oregon State Univ., Corvallis, USA. Dept. of Oceanography; Argonne National Lab., IL, USA. Radiological and Environmental Research Div.). *Earth and Planetary Science Letters;* **85**: No. 1-3, 1-10(Sep 1987).

Profiles of /sup 234/Th, /sup 232/Th, and /sup 230/Th in the Santa Monica Basin were measured. /sup 234/Th in the upper part of the water column suggests that the residence time of dissolved /sup 234/Th, with respect to adsorption onto and removal by particles, increases with depth, from 3-4 weeks at the surface to > 5 months below the euphotic zone. The partition of /sup 234/Th between dissolved and particulate forms points to a residence time of 4-7 days for particulate /sup 234/Th in the surface euphotic zone. Rapid removal of particulate /sup 234/Th from the surface water precludes the possibility of an adsorption-desorption equilibrium state between dissolved and particulate /sup 234/Th. Based on the /sup 230/Th data, the overall residence time of dissolved Th in the water column is estimated at 5-6 years. Both dissolved /sup 230/Th and /sup 232/Th profiles exhibit higher concentrations at the surface than immediately underneath, suggesting a terrestrial input for them. From the surface to the bottom of the water column, the concentration of dissolved /sup 232/Th decreases by a factor of 3-4, and the dissolved /sup 230/Th//sup 232/Th activity ratio increases by a factor of about five (from 2-3 to 9-12). This re-

flects the surface source of the terrestrial end-member and its removal at depth. On the average about 6% of the /sup 234/Th, 25% of the /sup 230/Th, and 50% of the /sup 232/Th were found in the particulate form, which is as expected and relates to their respective sources, to the difference in radioactivity decay half-life, and to the kinetics of the scavenging process.

7879 **Mass spectrometric determination of fallout /sup 239/Pu and /sup 240/Pu in marine samples.** Buesseler, K.O.; Halverson, J.E. (Woods Hole Oceanographic Institution, MA, USA; Savannah River Ecology Lab., Aiken, SC, USA). *Journal of Environmental Radioactivity (London);* 5: No. 6, 425-444(1987).

A thermal ionization mass spectrometric technique is presented for the detection of /sup 239/Pu and /sup 240/Pu in sea water, pore water, ocean sediments, sediment trap samples and coral samples. Both sample preparation and purification procedures, as well as the procedure used to deter Pu by mass spectrometry (m.s.), are presented. The m.s. technique proves to be over an order-of-magnitude more sensitive than traditional alpha-counting techniques for the detection of Pu in environmental samples. Also, the ratio of /sup 240/Pu//sup 239/Pu is obtained with this technique.

7880 **Chemical speciation of radionuclides in contaminant plumes at the Chalk River nuclear laboratories.** Champ, D.R.; Robertson, D.E. (Environmental Research Branch, Chalk River Nuclear Labs., Chalk River, Ontario K0J 1J0). pp 114-120 of Speciation of fission and activation products in the environment. Bulman, R.A.; Cooper, J.R. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-850473—).

From Seminar on the speciation of fission and activation products in the environment; Oxford, UK (16 Apr 1985).

Experimental disposals of liquid and glassified wastes directly into the sands of the Perch Lake basin, Ontario, Canada, have resulted in the formation of well-defined subsurface contaminant plumes in the groundwater flow system. Using large volume water sampling techniques the authors have detected low concentrations of several long-lived radionuclides including isotopes of Pu, Am, Cm, Tc, I, Sr and Cs. The particulate and ionic speciation results from these studies support the conclusions of previous laboratory column studies that transport of radionuclides, particularly Cs and Pu, on particulates and/or colloids could be a significant mobilization mechanism in groundwater flow systems. The authors also propose, based on a comparison of the plume data with previous detailed studies on /sup 60/Co that complexation reactions with natural as well as synthetic organic ligands can yield mobile anionic species of the actinides and lanthanides. Further detailed studies will be required to support this postulate.

7881 **Evaluation of a large-volume water sampling technique for determining the chemical speciation of radionuclides in groundwater.** Robertson, D.E. (Pacific Northwest Lab., Richland, WA 99352). pp 47-57 of Speciation of fission and activation products in the environment. Bulman, R.A.; Cooper, J.R. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-850473—).

From Seminar on the speciation of fission and activation products in the environment; Oxford, UK (16 Apr 1985).

A laboratory evaluation of a large volume water sampling technique was conducted to determine the effects of various environmental parameters on the retention behavior of radionuclides processed through the sampler. The Battelle Large Volume Water Sampler (BLVWS) consists of an inline membrane prefilter assembly connected to a housing containing multiple beds of cation resin, anion resin and activated aluminum oxide. This sampler quantitatively extracts radionuclides from large volumes (up to 4000 liters) and partitions are radionuclides according to their chemical forms. It is believed that pH reductions in the water passing through the H/sup +/ cation resin section disturbs the chemical equilibria of the species of radionuclides present in the water causing changes from anionic to cationic forms. By adding as little as 5 ppm of humic acid or EDTA, it was possible to simulate the anionic forms of /sup 54/Mn, /sup 60/Co, /sup 63/Ni, /sup 55/Fe, /sup 155/Eu and Pu observed in field sampling operations. The role of organic complexation of these radionuclides to form mobile anionic species is strongly implicated. Thus, the alternative use of Na/sup +/ and H/sup +/ cation resins, in combination with anion resin and aluminum oxide, appears to provide a technique for studying chemical speciation of radionuclides in groundwaters.

7882 **The role of natural dissolved organic compounds in determining the concentrations of Americium in natural waters.** Nelson, D.M.; Orlandini, K.A. (Argonne National Lab., Environmental Research Div., Argonne, IL 60439). pp 262-268 of Speciation of fission and activation products in the environment. Bulman, R.A.; Cooper, J.R. New York, NY; Elsevier Science Pub. Co. Inc. (1985). (CONF-850473—).

From Seminar on the speciation of fission and activation products in the environment; Oxford, UK (16 Apr 1985).

Concentrations of /sup 241/ Am, both in solution and bound to suspended particulate matter, have been measured in several North American lakes. Dissolved concentrations vary from 0.4 μBq/L to 85 Bq/L. The /sup 241/ Am in these lakes originated solely from global fallout and hence entered all lakes in the same physiocochemical form. The observed differences in solubility behavior must, therefore, be attributable to chemical and/or hydrological differences among the lakes. Concentrations of dissolved /sup 241/Am are highly correlated with the correlated with the corresponding concentrations of /sup 239,240/Pu(III, IV), suggesting that a common factor is responsible for maintaining both in solution. The K/sub D/ values for /sup 241/Am and /sup 239,240/Pu (III, IV) are highly correlated with the concentrations of dissolved organic carbon (DOC) in the waters, suggesting that the common factor is the formation of soluble complexes with natural DOC for both elements. This hypothesis was tested in a series of laboratory experiments in which the DOC from several of the lakes was isolated by ultrafiltration. Plots of K/sub D/, as a function of DOC concentration, show K/sub D/ to be very high (—10/sup 6/) at low DOC concentrations. Above critical concentrations (a few mg/L DOC) the K/sub D/ values begin a progressive decrease with increasing DOC. We conclude that in most surface waters, the dissolved /sup 241/Am concentration is regulated by an adsorption/desorption equilibrium with the sediments (and suspended solids) and the value of K/sub D/ that characterizes this equilibrium is largely determined by the concentration of natural DOC in the water.

## 5204 Thermal Effluents Monitoring And Transport

*REFER ALSO TO CITATION(S) 7858*

## 5205 Site Resource And Use Studies

7883 **(DOE/BP/63584—1) Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary dam: Annual progress report, July 1986-March 1987.** (Oregon Dept. of Fish and Wildlife, Portland (USA); Washington State Dept. of Fisheries, Olympia (USA); Fish and Wildlife Service, Portland, OR (USA); National Marine Fisheries Service, Portland, OR (USA)). Jun 1987. Contract AI79-86BP63584. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87014304/JAW.

Individual projects are processed separately for the data bases. (CBS)

7884 (DOE/BP/63584—1, pp 7-24) **Appendix A.** Rieman, B.E.; Elliott, J.C.; Nigro, A.A. (Oregon Dept. of Fish and Wildlife, Portland). Jun 1987. NTIS, PC A04/MF A01. Order Number DE87014304/JAW.

In Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary dam: Annual progress report, July 1986-March 1987.

We reviewed methods and gear for sampling and marking white sturgeon Acipenser transmontanus. We selected setlines and gillnets as our primary gear; sport and commercial catch surveys and entrapment in turbine draft tubes as our secondary gear; and a combination of tags, tattoos, and clips as our marking procedure. We began work to evaluate these methods. We identified popula-

tion characteristics to be described and made preliminary analysis of available data using a population simulation model and the Ricker equilibrium yield model. The sampling and marking procedures may have some limitations that could result in bias or poor precision in results. Work during the first year was designed to identify and minimize those limitations. Data on population characteristics of growth, mortality, and reproductive potential are limited. Models are sensitive to mortality and reproductive potential. The development of extensive data on these characteristics will be important in this study. 9 refs.

7885 (DOE/BP/63584—1, pp 25-37) **Appendix B.** Kreitman, G.; James, B. (Washington Dept. of Fisheries, Battle Ground). Jun 1987. NTIS, PC A04/MF A01. Order Number DE87014304/JAW.

In Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary dam: Annual progress report, July 1986-March 1987.

References on white sturgeon, Acipenser transmontanus, life history and population dynamics were compiled through computer searches of the general literature, and by contacting other research or management entities. Review and summarization of existing data for its applicability to modeling white sturgeon population dynamics commenced. Data base formats and codes were formulated for use in a common computer data base. Analysis of existing program data downstream from Bonneville Dam identified the need for additional data on growth, natural mortality, reproduction potential, and age structure. Totals of 179 white sturgeon from above, and 511 from below Bonneville Dam were sampled during commercial fisheries for mark, biological profiling, and harvest data. Preparations were made for the June and July 1987 angler survey in The Dalles reservoir. Sampling downstream from Bonneville Dam for sturgeon eggs and larvae commenced 18 March 1987. No eggs or larvae were observed at that time. 6 refs.

7886 (DOE/BP/63584—1, pp 38-48) **Appendix C.** Beckman, L.G.; Palmer, D.E.; Parsley, M.J. (US Fish and Wildlife Service, Cook, WA). Jun 1987. NTIS, PC A04/MF A01. Order Number DE87014304/JAW.

In Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary dam: Annual progress report, July 1986-March 1987.

Primary study responsibilities of the Fish and Wildlife Service (FWS) are concerned with describing the reproduction and early life history characteristics of white sturgeon populations and defining habitat requirements for their spawning and rearing. The FWS plans to initiate field operations in The Dalles pool in April with a variety of sampling techniques and gear types to collect eggs, larvae, and juveniles. The primary objective this first year will be to develop a standardized sampling system. Field preparations have been completed, a literature review has been conducted, and obtaining a "Key-Collection" of early life stages is in progress. The project is closely coordinated among the participating agencies to assure comparable results. 8 refs.

7887 (DOE/BP/63584—1, pp 49-60) **Appendix D.** McCabe, G.T. Jr.; McConnell, R.J. (National Marine Fisheries Service, Seattle, WA). Jun 1987. NTIS, PC A04/MF A01. Order Number DE87014304/JAW.

In Status and habitat requirements of white sturgeon populations in the Columbia River downstream from McNary dam: Annual progress report, July 1986-March 1987.

From October 1986 to April 1987 the National Marine Fisheries Service (NMFS) prepared for sampling white sturgeon Acipenser transmontanus eggs, larvae, young-of-the-year, and subadults in the Columbia River downstream from Bonneville Dam. NMFS and the Washington Department of Fisheries began a cooperative sampling effort for white sturgeon eggs and larvae in the Columbia River downstream from Bonneville Dam in March 1987. No eggs or larvae were collected during the March sampling. A review of the pertinent white sturgeon literature was completed. In addition, NMFS began recoding and entering past NMFS white sturgeon data into computer files, following a data format tentatively agreed to by the four agencies involved in this study. 17 refs.

### 5206 Regulations

*REFER ALSO TO CITATION(S) 7551, 7553, 7554, 7850, 7859, 7860, 7861, 7890, 7891, 7892, 7893*

7888 **(PB—88-100169/XAB) Type B technical information document: injury to fish and wildlife species.** (Fish and Wildlife Service, Washington, DC (USA)). Jun 1987. 159p. NTIS, PC A08/MF A01.

See also PB—88-100151; Also available in set of 5 reports PC E99, PB—88-100110.

This document provides technical information for use with the 43 CFR Part 11 regulations for type B natural-resource damage assessments. The document has been prepared in conjunction with the development of the type B regulations. The purpose of the document is to identify various types of adverse biological responses that can be used to demonstrate injury to fish and wildlife species resulting from a discharge of oil or a release of a hazardous substance. The document also shows the application of the biological-acceptance criteria contained in the type B regulations. The acceptance criteria are to be used for evaluating the acceptability of a particular biological response for demonstrating injury to any biological resource. The document provides further technical information and literature citations pertaining to various testing and sampling procedures for specific biological responses of fish and wildlife species that have met the acceptance criteria. The information in the document supplements the guidance provided in 43 CFR Part 11, but is not required to be followed to obtain the rebuttable presumption provided by those regulations.

7889 **(PB—88-111596/XAB) Report to Congress: Class V injection wells - current inventory; effects on ground water; technical recommendations. Final report.** (Environmental Protection Agency, Washington, DC (USA). Office of Drinking Water). Sep 1987. 745p. (EPA—570/9-87/006). NTIS, PC A99/MF E04.

The report to Congress, summarizes the results of State surveys concerning Class V injection wells as defined by the 1986 Amendments to the Safe Drinking Water Act. In accordance with the Act, the report (1) identifies the categories and corresponding inventories of Class V wells in the United States and its Territories and Possessions, (2) describes primary contamination problems associated with different categories of these wells, and (3) summarizes recommendations for minimum design, construction, installation, and siting requirements that could be applied to protect underground sources of drinking water (USDW) from such contamination wherever necessary including corrective action and remedial action recommendations.

## 53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

### 5302 Assessment Of Energy Technologies

*REFER ALSO TO CITATION(S) 7851*

7890 **(PB—88-100490/XAB) Draft environmental impact statement for the New Hampshire Coastal Program for ocean, harbor and great bay areas. Appendices.** (National Oceanic and Atmospheric Administration, Washington, DC (USA). Office of Ocean and Coastal Resource Management). May 1987. 154p. (OCRM—87-8). NTIS, PC A08.

See also PB—88-100508; Portions of this document are not fully legible.

The appendices contain the regulations in existing statutes.

7891 **(PB—88-100508/XAB) Draft environmental impact statement for the New Hampshire Coastal Program for ocean, harbor, and great bay areas.** (National Oceanic and Atmospheric Administration, Washington, DC (USA). Office of Ocean and Coastal Resource Management). May 1987. 219p. (OCRM—87-7). NTIS, PC A10/MF A01.

See also PB—88-100490.

The report contains a management program for coastal land- and water-use activities. It consists of numerous policies on diverse management issues administered under existing state laws and is the culmination of several years of program development. The effect of these policies is to condition, restrict, or prohibit various uses in parts of the coastal zone while encouraging development and other uses in other parts. The New Hampshire Coastal Program will improve decision-making processes for determining appropriate coastal land and water uses in light of resource considerations and increase public awareness of coastal resources. It may result in some short-term economic impacts on coastal users but will lead to increased long-term protection of the state's coastal resources and improve the responsiveness of state programs.

7892 **(PB—88-100581/XAB) Commonwealth of Virginia Coastal Resources Management Program and draft environmental impact statement. Volume 1.** (National Oceanic and Atmospheric Administration, Washington, DC (USA). Office of Ocean and Coastal Resource Management). Aug 1985. 203p. (OCRM—87-11). NTIS, PC A10/MF A01.

See also Volume 2, PB—88-100599.

The Commonwealth of Virginia has submitted its Coastal Resources Management Program to the Office of Ocean and Coastal Resource Management for approval. Approval would allow program administrative grants to be awarded to the Commonwealth and would require that Federal actions be consistent with the program. The document includes a copy of the program which is a comprehensive management program for coastal land- and water-use activities. Virginia's coastal management program either promotes the beneficial use of coastal resources, prevents their impairment, or deals with major activities that substantially affect numerous resources.

7893 **(PB—88-100599/XAB) Commonwealth of Virginia Coastal Resources Management Program and draft environmental impact statement. Volume 2. Appendices.** (National Oceanic and Atmospheric Administration, Washington, DC (USA). Office of Ocean and Coastal Resource Management). Aug 1985. 305p. (OCRM—87-12). NTIS, PC A14/MF A01.

See also Volume 1, PB—88-100581; Portions of this document are not fully legible.

The report contains 19 appendixes which includes a list of activities that contribute to the management of Virginia's coastal resources. A list of State agencies which administer these functions is included in the report.

# 55 BIOMEDICAL SCIENCES, BASIC STUDIES

## 5502 Biochemistry

7894 **Haloperoxidase reactions catalyzed by lignin peroxidase, an extracellular enzyme from the basidiomycete Phanerochaete chrysosporium.** Renganathan, V.; Miki, K.; Gold, M.H. (Oregon Graduate Center, Beaverton). *Biochemistry;* **26**: No. 16, 5127-5132(11 Aug 1987). Contract FG06-86ER13550.

Lignin peroxidase (ligninase, LiP) an $H_2O_2$-dependent lignin-degrading heme enzyme from the basidiomycetous fungus Phanerochaete chrysosporium, catalyzes the oxidation of a variety of lignin model compounds. In this paper the authors examine the haloperoxidase reactions of LiP. In the presence of $H_2O_2$, homogeneous LiP oxidized bromide and iodide but not chloride. Halide oxidation was measured by the halogenation of monochlorodimedone (MCD) and a variety of other aromatic compounds. Bromination of MCD produced monochloromonobromodimedone. The pH optimum for the bromination of MCD was 3.5. Both chloride and fluoride inhibited the bromination reaction. LiP binds halides to produce characteristic optical difference spectra. From these spectra apparent dissociation constants for fluoride and chloride were determined to be 0.3 and 20 mM, respectively. Incubation of LiP with bromide and $H_2O_2$ in the absence of organic substrate led to the bleaching of the heme as measured by a decrease in Soret maximum. LiP brominated a variety of aromatic substrates including 3,4-dimethoxybenzyl alcohol (veratryl alcohol) to produce 6-bromoveratryl alcohol (VII). LiP hydrobrominated cinnamic acid (IV) to produce 2-bromo-3-hydroxy-3-phenylpropionic acid (XII). In an analogous reaction LiP hydrobrominated 1-(4-ethoxy-3-methoxyphenyl)propene (II) to produce 2-bromo-1-(4-ethoxy-3-methoxyphenyl)-1-hydroxypropane (XIII). Finally, with 3,4-dimethoxycinnamic acid as the substrate, three bromination products were identified: trans-2-bromo-1-(3,4-dimethoxyphenyl)ethylene (IX), 2,2-dibromo-1-(3,4-dimethoxyphenyl)-1-hydroxyethane (X), and 2-bromo-3-(3,4-dimethoxyphenyl)-3-hydroxypropionic acid (XI).

## 5503 Cytology

*REFER ALSO TO CITATION(S) 7919*

7895 **Quantitative imaging and microanalysis with a scanning soft x-ray microscope.** Jacobsen, C.; Kenney, J.M.; Kirz, J.; Rosser, R.J.; Cinotti, F.; Rarback, H.; Pine, J. (State Univ. of New York, Stony Brook, USA. Dept. of Physics; Brookhaven National Lab., Upton, NY, USA; California Inst. of Tech., Pasadena, USA). *Physics in Medicine and Biology;* **32**: No. 4, 431-437(Apr 1987).

A scanning soft x-ray microscope has been developed that uses synchrotron radiation focused by a Fresnel zone plate to form a submicron beamspot on the specimen. Transmitted x-rays are detected and used to form a quantitative map of specimen absorptivity. Applications of the instrument to the imaging of whole wet cells and to the mapping of calcium in sections of bone are presented, with a resolution of 300 nm and an elemental sensitivity of 2 $\mu g\ cm^{-2}$.

## 5504 Genetics

*REFER ALSO TO CITATION(S) 7386, 7915*

7896 **Allelic inclusion in a pre-B-cell line that generates immunoglobulin heavy chain genes in vitro.** Beck-Engeser, G.; Jaeck, H.M.; Wabl, M. (Univ. of California, San Francisco). *Proceedings of the National Academy of Sciences of the United States of America;* **84**: No. 4, 1060-1064(Feb 1987). Contract AC03-76SF01012.

In a pre-B-cell line that rearranges its heavy chain gene segments in vitro, the authors found that the rate of productive rearrangement on one allele was not influenced by the presence of heavy chain protein encoded by the other allele. This shows that allelic exclusion of heavy chain genes is not regulated at the genetic level. Cells were labelled with [$^{35}$S]methionine. RNA was probed with a [$^{32}$P]cDNA probe.

## 5505 Metabolism

*REFER ALSO TO CITATION(S) 7298, 7900*

7897 **(DOE/ER/60039—T3) [Development of gamma-emitting, receptor-binding radiotracers for imaging the brain and pancreas]: Progress report, March 1, 1987-February 28, 1988.** (George Washington Univ., Washington, DC (USA)). 1987. Contract AS05-82ER60039. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002552/JAW.

3-Quinuclidinyl atrolactate (QNA) is an analogue of 3-quinuclidinyl benzilate (QNB) which exhibits a 25-fold higher affinity for the muscarinic acetylcholine receptor (m-AChR) from the corpus striatum than for the m-AChR from ventricular muscle. A radioiodinated derivative of QNA can be used to bind high affinity m-AChR selectively in the CNS. A simple method was developed to radioiodinate QNB which has been applied to QNA, using a milligram amount of QNA as substrate. Two reaction steps were involved: QNA was reacted with thallic trifluoroacetate at 60°C for 24 hours in trifluoroacetic acid, then radioactive I-125/NaI and aluminum chloride were added to the reaction mixture and the reaction was allowed to continue at 70°C for another 24 hours. The above reactions were carried out in a sealed ampule. High performance liquid chromatography was employed for the separation of re-

action products. The mole ratio of QNA:aluminum chloride:thallic trifluoroacetate was 1:1:1. the radiochemical yield of [3-I-125]QNA was 8%. The specific activity was 35 Ci/mmole and the equilibrium association constant was $2.36 \times 10^7\ M^{-1}$. This low affinity indicates a stearic interaction in the 3-position of the phenyl ring of QNA. 1 fig.

## 5506 Medicine

*REFER ALSO TO CITATION(S) 7897, 8163*

**7898 (CONF-8708173—1) New radiohalogenated alkenyl tellurium fatty acids.** Srivastava, P.C.; Knapp, F.F. Jr.; Kabalka, G.W. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001767/JAW.

From 5. international symposium on the chemistry of selenium and tellurium; Oak Ridge, TN, USA (24 Aug 1987).

Radiolabeled long-chain fatty acids have diagnostic value as radiopharmaceutical tools in myocardial imaging. Some applications of these fatty acids are limited due to their natural metabolic degradation in vivo with subsequent washout of the radioactivity from the myocardium. The identification of structural features that will increase the myocardial residence time without decreasing the heart uptake of long-chain fatty acids is of interest. Fatty acids containing the tellurium heteroatom were the first modified fatty acids developed that show unique prolonged myocardial retention and low blood levels. Our detailed studies with radioiodinated vinyliodide substituted tellurium fatty acids demonstrate that heart uptake is a function of the tellurium position. New techniques of tellurium and organoborane chemistry have been developed for the synthesis of a variety of radioiodinated iodoalkenyl tellurium fatty acids. 9 refs., 3 figs., 2 tabs.

**7899 (DOE/ER/60460—T1) In vivo studies of branched chain fatty acids.** Strauss, H.W.; Livni, E.; Brill, B.; Knapp, F.F.; Barlai-Kovich, M.; Keiss, M.C.; Elmaleh, D.R. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract FG02-86ER60460. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002585/JAW.

Studies using [1-C-11]-3-methylheptadecanoic acid (BMHDA) have been performed both in animals and man to define the characteristics of the agent. Evaluation of BMHDA as a myocardial imaging agent in anesthetized dogs revealed blood clearance half times of less than 2 minutes accompanied by prompt myocardial concentration. Within 2 minutes the myocardium could be delineated, Plateau myocardial concentration of 3 to 4% of the injected dose was observed. This value persisted for intervals up to 70 minutes. In addition to the heart, the liver was the only other organ clearly delineated. The prompt concentration of fatty acid in the myocardium and the rapid blood clearance raised the spectre that the fatty acids may behave as Sapirstein tracers in the myocardium - i.e., their distribution may be dominated by regional perfusion and, thereby, make these agents less useful as independent indicators of myocardial metabolism. The effects of severe chronic hypertension of myocardial uptake of BMHDA was studied. These experiments were designed to define whether the myocardium continues to utilize fatty acids as a major substrate when myocardial work is excessive. 7 refs.

**7900 (DOE/ER/60460—T2) Biochemical rationale for the use of fatty acid analogs as agents for studying myocardial metabolism.** Elmaleh D.R.; Livni E.; Brownell, G.L.; Strauss, H.W. (Massachusetts Inst. of Tech., Cambridge (USA)). 1987. Contract FG02-86ER60460. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002587/JAW.

Since fatty acids are the major energy source for myocardial contractile work, the rate of utilization of these substrates/unit work performed, should be an indicator of the health of the muscle. [1-C-11] palmitic acid has been shown to be useful as a myocardial imaging agent for positron tomography. The main limitations for the use of this substrate are the fast washout and translocation of the activity from the normal myocardium and the back diffusion in ischemia. Since alpha and omega oxidation are only present to a limited degree, branched chain fatty acids should have a prolonged residence time in the myocardium. The similarity in structure, chain length, solubility, and charge of the branched to the non-branched fatty acids should make these compounds behave in similar fashion in terms of their blood clearance and entry into tissues. 15 refs., 3 tabs.

**7901 (INIS-mf—11066) Movement disorders. A study with positron emission tomography.** Leenders, K.L. (Vrije Univ., Amsterdam (Netherlands)). 7 Nov 1986. 271p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88700810/JAW.

Includes summary in Dutch and previously published material.

This thesis describes the measurement of brain-tissue functions in patients with movement disorders using positron emission tomography (PET). This scanning technique is a method for direct in vivo quantitation of the regional tissue content of positron emitting radionuclides in brain (or other organs) in an essentially non-invasive way. Ch. 2 outlines some general features of PET and describes the scanner which has been used for the studies in this thesis. Also the tracer methodology, as applied to data investigations of movement disorders, are discussed. Ch. 3 contains the results of the PET investigations which were performed in the study of movement disorders. The results are presented in the form of 12 papers. The main goals of these studies were the understanding of the pathophysiology of Parkinson's disease, Huntington's chorea, Steele-Richardson-Olzewski syndrome and special case reports. Ch. 4 summarizes the results of these publications and Ch. 5 concludes the main part of this thesis with a general discussion of movement disorders in relation to PET investigations. 697 refs.; 60 figs.; 31 tabs.

**7902 (INIS-mf—11067) Radiologic techniques in staging malignant lymphoma.** Strijk, S.P. (Katholieke Univ. Nijmegen (Netherlands)). 16 Jan 1987. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700811/JAW.

Includes summary in Dutch and previously published material.

The main subject of this thesis is the evaluation of radiologic techniques in staging patients with newly diagnosed and untreated malignant lymphoma, or restaging patients with recurrent disease after a period of complete remission. Lymphography and, more recently, CT are available to examine the infradiaphragmatic nodes. CT also offers the possibility to examine other organ systems in the abdomen, and to visualize more lymph-node regions than lymphography. In ch. 2 and 4 the diagnostic performance of CT and lymphography in HD and NHL respectively are discussed. Literature data are summarized, and own results are given. The main goal is to determine whether the two methods are overlapping, competitive or complementary, and to answer the question what would be required for optimal staging. Staging laparotomy showed the unreliability of non-invasive examination methods for determining the presence or absence of lymphoma in the spleen. In ch. 3 and 5 the results of CT-based estimations of size of the spleen in relation to its histologic state, in patients with HD and NHL respectively are presented. The chest can be examined for lymphoma by conventional radiography, conventional tomography or computed tomography (CT). In ch. 6 the literature is reviewed, and the results with our patients are presented. The diagnostic performance of each examination is evaluated, and the results are analysed to define the most desirable approach in the examination of the chest for staging purposes. In ch. 7 the uncommon radiologic observation of calcification in lymph nodes, afflicted with HD and NHL is described. The literature is reviewed, and the clinical significance is indicated. 180 refs.; 22 figs.; 24 tabs.

**7903 (INIS-mf—11070) Investigation on clinical, radiological and biochemical methods for assessing periodontitis activity.** Janssen, P.T.M. (Rijksuniversiteit Utrecht (Netherlands)). 23 Jun 1987. 152p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88700814/JAW.

Includes summary in Dutch and previously published material.

In order to recognize in which stage rapidly progressing destruction of periodontal ligament fibers occurs, a number of diagnostic methods are studied in this thesis. It turns out that the actual much utilized clinical methods can not be improved while radiological and biochemical diagnositic methods are much more promising. 106 refs.; 20 figs.; 36 tabs.

7904 **Large reservoir of sulfate and sulfonate resides within plasma cells from Ascidia ceratodes, revealed by x-ray absorption near-edge structure spectroscopy.** Frank, P.; Hedman, B.; Carlson, R.M.K.; Tyson, T.A.; Roe, A.L.; Hodgson, K.O. (Stanford Univ., CA). *Biochemistry;* **26**: No. 16, 4975-4979(11 Aug 1987).

The study of sulfur within the plasma cells of Ascidia ceratodes has been extended with x-ray absorption near-edge structure (XANES) spectroscopy. An intense absorption feature at 2482.4 eV and a second feature at 2473.7 eV indicate a large endogenous sulfate concentration, as well as smaller though significant amounts of thiol or thioether sulfur, respectively. A strong shoulder was observed at 2481.7 eV on the low-energy side of the sulfate absorption edge, deriving from a novel type of sulfur having a slightly lower oxidation state than sulfate sulfur. The line width of the primary transition on the sulfur edge of a vanadium(III) sulfate solution was found to be broadened relative to that of sodium sulfate, possibly deriving from the formation of the $VSO_4^+$ complex ion. Similar broadening appears to characterize the oxidized sulfur types in vanadocytes. A very good linear correlation between oxidation state and peak position (in electronvolts) was found for a series of related sulfur compounds. This correlation was used to determine a 5+ oxidation state for the additional sulfur type at 2481.7 eV. Construction of a cellular sulfur minus vanadium(III) sulfate difference spectrum, along with comparison with spectra of known compounds, identified the novel sulfur(V) as an aliphatic sulfonic acid analogous to cysteic acid. The overall sulfonic acid concentration is comparable to that of sulfate in plasma cells and appears to be unprecedented in marine organisms.

7905 **Fluorodeoxyglucose rate constants, lumped constant, and glucose metabolic rate in rabbit heart.** Krivokapich, J.; Huang, S.C.; Selin, C.E.; Phelps, M.E. (Univ. of California, Los Angeles). *American Journal of Physiology;* **252**: No. 4, H777-H787(Apr 1987).

The isolated arterial perfused rabbit interventricular septum was used to measure myocardial metabolic rate for glucose (MMRGlc) and rate constants and lumped constant (LC) for the glucose analogue [$^{18}$F]fluorodeoxyglucose (FDG) using a tracer kinetic model. FDG was delivered by constant infusion during coincidence counting of tissue $^{18}$F radioactivity. The MMRGlc was measured by the Fick method. Control septa were paced at 72 beats/min and perfused at 1.5 ml/min with oxygenated perfusate containing 5.6 mM glucose and 5 mU/ml insulin. The following conditions were tested: 3.0 and 4.5 ml/min; insulin increased to 25 mU/ml; insulin omitted; 2.8 mM and 11.2 mM glucose; 144 beats/min and 96 paired stimuli/min; and anoxia. Under all conditions studied the phosphorylation (hexokinase) reaction was rate limiting relative to transport. Compared with control conditions, the phosphorylation rate constant was significantly increased with 2.8 mM glucose as well as in anoxia. With 4.5 ml/min and 11.2 mM glucose, conditions that should increase glucose flux into tissue without increasing demand, the phosphorylation rate constant decreased significantly. With 11.2 mM glucose, 96 paired stimuli/min, and anoxia without insulin, a significant increase in the hydrolysis rate of FDG 6-phosphate was observed and suggests that hydrolysis is also an important mechanism for regulating the MMRGlc. Increased transport rate constants were observed with increased flow rates, 96 paired stimuli/min, and anoxia at 96 beats/min. The LC was not significantly different from control in 11 of 14 conditions studied. Therefore, under most conditions in average LC can be used to calculate MMRGlc estimates.

7906 **Biodistribution of radiolabeled antilymphocyte monoclonal antibody in the rat.** Fawwaz, R.A.; Oluwole, S.; Iga, C.; Wang, T.; Rosen, J.M.; Hardy, M.A.; Alderson, P.O.; Srivastava, S. (Columbia Univ., New York, USA; Brookhaven National Lab., Upton, NY, USA). *Nuclear Medicine and Biology;* **13**: No. 1, 39-42(1986).

The biodistribution of radiolabeled mouse anti-pan T monoclonal antibody (W3/13) against rat lymphocytes was examined in normal rats. Monoclonal antibody to human prostate-associated antigens (PAA) served as a control. In vitro studies demonstrated a 38% maximum binding of radiolabeled W3/13 to lymphocytes, which was significant when compared with the control (PAA) value of 3.4%. In vivo, intravenously administered $^{111}$In labeled W3/13 and $^{131}$I labeled W3/13 exhibited similar tissue distribution patterns. The localization of W3/13 in lymphoid tissue was significantly greater than that achieved with PAA. W3/13, however, did not demonstrate significant localization in the intact thymus and accumulated to a higher degree (6-10% ID/g) than expected in bone marrow at 24 h. These findings suggest that radiolabeled anti-lymphocyte monoclonal antibodies may not be well suited for the treatment of lymphoreticular neoplasms and allograft rejection in patients.

7907 **Direct comparison of the brain uptake and plasma clearance of N-[$^{11}$C]methylspiroperidol and [$^{18}$F]N-methylspiroperidol in baboon using PET.** Fowler, J.S.; Arnett, C.D.; Wolf, A.P.; Shiue, Chyng-Yann; MacGregor, R.R.; Halldin, C.; Laangstroem, B.; Wagner, H.N. Jr. (Brookhaven National Lab., Upton, NY, USA; Uppsala Univ., SE. Inst. of Chemistry; Johns Hopkins Medical Institutions, Baltimore, MD, USA. Div. of Nuclear Medicine). *Nuclear Medicine and Biology;* **13**: No. 3, 281-284(1986).

Serial PET studies of N-[$^{11}$C]methylspiroperidol and [$^{18}$F]N-methylspiroperidol were carried out in a single baboon with an intervening time period of 2 h between injection of the $^{11}$C and the $^{18}$F-labeled tracers. The kinetic patterns of uptake and egress of radioactivity in striatum and cerebellum as well as the magnitude of the uptake was very similar with the two tracers. No significant difference in clearance of total radioactivity from arterial plasma was detected. Analysis of plasma radioactivity for unchanged drug showed no significant differences in the amount of unchanged tracer at different times, although the profile of labeled metabolites was different. These results indicate that the only significant difference between the use of N-[$^{11}$C]methylspiroperidol and [$^{18}$F]N-methylspiroperidol for PET studies of brain dopamine receptors relate to the difference in physical half-life of the radionuclide rather than to differences in the profile of metabolically produced labeled compounds.

### 5508 Morphology

*REFER ALSO TO CITATION(S) 7897*

### 5520 Public Health

*REFER ALSO TO CITATION(S) 7555, 7817, 7819, 7821, 7822, 7823, 7824, 7825, 7916*

### 5530 Agriculture And Food Technology

*REFER ALSO TO CITATION(S) 7875*

## 56 BIOMEDICAL SCIENCES, APPLIED STUDIES

### 5601 Radiation Effects

*REFER ALSO TO CITATION(S) 7910*

7908 **(CEPN—101) Dose response relationship and Alara.** Hubert, P. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751366/JAW.

In this paper, it will be shown how dose-response relationships allow to give quantitative figures for the detriment of irradiation. At this stage, the detriment is expressed directly as a certain

number of health effects, whose valuation is not dealt with here. The present tools for quantifying, their weaknesses and their strenghts, and their scientific basis will be developed.

7909 **(DOE/EV/03267—2) Improved mutagen-testing systems in mice: Comprehensive progress report, 1 September 1984 to 31 August 1987.** Roderick, T.H. (Jackson Lab., Bar Harbor, ME (USA)). 30 Sep 1987. Contract AC02-76EV03267. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002097/JAW.

The purpose of this project is to produce improved mutagen-testing systems in mice. Our approach is to produce chromosomal inversion systems in order to improve the techniques necessary to induce, detect, genetically define, and combine inversions in effective and useful mutation-test systems. Another specific objective has been to validate and test the systems produced with respect to their effectiveness in uncovering induced or naturally occurring recessive detrimentals or recessive lethals. Another object has been to mark, maintain, and study these induced recessive lethals induced during the validation-testing. A final broad objective has been to use the induced inversions and recessive lethals for studies of basic problems in mammalian genetics, genetic recombination, gene mapping, fertility, growth, and development.

7910 **(DOE/EV/70007—T2) Repair of damaged DNA in vivo: Final technical report.** Hanawalt, P.C. (Stanford Univ., CA (USA). Dept. of Biological Sciences). Sep 1987. Contract AS03-76EV70007. 28p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001622/JAW.

This contract was initiated in 1962 with the US Atomic Energy Commission to carry out basic research on the effects of radiation on the process of DNA replication in bacteria. Within the first contract year we discovered repair replication at the same time that Setlow and Carrier discovered pyrimidine dimer excision. These discoveries led to the elucidation of the process of excision-repair, one of the most important mechanisms by which living systems, including humans, respond to structural damage in their genetic material. We improved methodology for distinguishing repair replication from semiconservative replication and instructed others in these techniques. Painter then was the first to demonstrate repair replication in ultraviolet irradiated human cells. He, in turn, instructed James Cleaver who discovered that skin fibroblasts from patients with xeroderma pigmentosum were defective in excision-repair. People with this genetic defect are extremely sensitive to sunlight and they develop carcinomas and melanomas of the skin with high frequency. The existence of this hereditary disease attests to the importance of DNA repair in man. We certainly could not survive in the normal ultraviolet flux from the sun if our DNA were not continuously monitored for damage and repaired. Other hereditary diseases such as ataxia telangiectasia, Cockayne's syndrome, Blooms syndrome and Fanconi's anemia also involve deficiencies in DNA damage processing. The field of DNA repair has developed rapidly as we have learned that most environmental chemical carcinogens as well as radiation produce repairable damage in DNA. 251 refs.

7911 **(INIS-mf—10754) Influence of whole-body irradiation with combined ultraviolet/infrared light on the spermiogram.** Witt, W. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Medizinische Fakultaet). 16 Apr 1984. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751281/JAW.

We irradiated for six weeks two times a week 10 volunteer subjects with a UV/IR-radiation source and evaluated the spermiogram every week. The subjects were divided in 3 groups with various light sensitivities (high, medium, low), in order to achieve a similar erythematous intensity. No relation to the irradiation could be found in any of the spermiogram parameters (sperm density, total sperm number, motility, vitality, ejaculation quantity, fructose, pH value). A direct effect as a result of photochemical changes of the cells of spermatogenesis is not possible because of the limited penetration ability of the used radiation. The temperature increase as a result of the UV/IR irradiation was too small to result in a decrease of spermatozoan concentration, as can be expected by stronger warming of the testicles. An indirect effect of the UV/IR irradiation in the sense of an influence on spermatogenesis via the involuntary nervous system -> hypophysis -> sexual hormone could not be determined by us.

7912 **(NCRP—91) Recommendations on limits for exposure to ionizing radiation.** (National Council on Radiation Protection and Measurements, Bethesda, MD (USA)). 1 Jun 1987. 81p. National Council on Radiation Protection and Measurements, 7910 Woodmont Ave., Bethesda, MD 20814. Order Number TI88900028/JAW.

This report lists the existing standards or the status of regulations for 19 major topic areas related to exposure to ionizing radiation. Most entries are brief but thorough; some reference recent data. The National Council on Radiation Protection and Measurements (NCRP) published its last complete set of basic recommendations specifying limits for ionizing radiation in 1971. Although this report is not intended to be a complete revision, the recommendations contained herein replace all of the recommendations given in the 1971 Report. In addition, this report contains other basic recommendations. The NCRP believes that a logical direction in the evolution of the basis of radiation protection standards from the present system based on dose equivalent used by the NCRP and the ICRP is toward the development of an approach based specifically on risk. The Council believes that additional review and evaluation are required prior to the introduction of a radiation protection system in which the limitation of exposures is based solely on risk. For the present the Council adopts the effective dose equivalent system used by the ICRP, but has modified and updated this approach in several respects, as discussed in this report.

7913 **Lens and cataract: clastogenic responses in epithelial cells of the organ-cultured rat lens.** Geard, C.R.; Worgul, B.V. (Columbia Univ., New York, NY). *Environmental Mutagenesis;* 9: No. 2, 111-122(1987). Contract AC02-83ER60142.

The epithelial cells of the vertebrate lens have an unique character and a probable involvement in cataract formation, which could be initiated by exogenous stimuli. Individual rat lenses were organ-cultured, and the effects of mitomycin C and gamma rays on sister chromatid exchanges (SCE), chromosomal aberrations, and cellular kinetics assessed in cells from the epithelial monolayer. SCE showed about a 5.5-fold increase over the mitomycin C dose range (0, 17, 83, 170 nM), while chromosomal aberrations increased 38-fold. In cells from untreated lenses, SCE were 1600 times more frequent than aberrations and at a level consistent with in vivo assessments in other cell types. Gamma rays (up to 4 Gy) had a greater inhibiting effect on cellular progression, while 17 nM mitomycin C and 1 Gy induced similar clastogenic responses. This first demonstration of such changes in lens epithelial cells expands on the cell types available for monitoring potential mutagen-carcinogens. Additionally chromosomal changes resulting from lens cellular challenge could be the basis of later cytopathological changes in the lens, of which cataract is the primary concern to humans. Potential cataractogens warrant monitoring, and the study outlined may aid in this endeavor, as well as contributing to an understanding of cataract etiology.

## 5603 Chemicals Metabolism And Toxicology

*REFER ALSO TO CITATION(S) 7844, 7845, 7846, 7867, 7888, 7909, 7913*

7914 **(EUR—10546) Study on the need for an NO/sub 2/ long-term limit value for the protection of terrestrial and aquatic ecosystems.** Zierock, K.H.; Mansfield, T.A.; Posthumus, A.C. Leuw, F. de; Guderian, R.; Lee, J.A.; Apling, A.; Hamelin, M.; Nicolai, R. (Commission of the European Communities, Luxembourg). 1986. 220p. Commission of the European Communities, Luxembourg.

The report gives results on the following issues which have been studied in order to examine the question if a long-term limit value for NO is needed: the effects of NO/sub 2/ as a single compound on vegetation; the effects on vegetation of NO/sub 2/ in combination with other pollutants; the contribution of NO/sub 2/ to effects on soils; the effects of NO/sub 2/ on aquatic ecosystems; the effects of secondary pollutants, in particular photochemical oxidants which are created in processes involving NO/sub 2/, on

vegetation; the need to lay down a long-term limit value for administrative and air quality management purposes; the consequences of a long-term limit value for the production of photochemical oxidants; the consequences of such a value for emission reduction measures and monitoring. Therefore, the study group concluded that at present no long-term limit value for NO/sub 2/ can be proposed.

7915 **(PB—88-102769/XAB) Assessment of genotoxicity of hazardous wastes with the Arabidopsis embryo assay.** Sandhu, S.S.; Acedo, G.N. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Sep 1987. 21p. (EPA—600/D-87/272). NTIS, PC A03/MF A01.

This paper summarizes the results of evaluating the genetic effects of five samples obtained from a mercuric acetate plant in New Jersey. The samples were tested in Arabidopsis thaliana embryo assay after extraction with methylene chloride and water leachate and as crude samples. These samples had been previously evaluated for mutagenicity in Salmonella typhimurium and a few in mouse lymphoma thymidine kinase assay. The study shows that the results obtained in Arabidopsis assay were in agreement with Salmonella and mouse lymphoma assays with the added advantage that the system is very cost effective and does not need exogenous metabolic activation.

7916 **(PB—88-107628/XAB) Summary review of health effects associated with zinc and zinc oxide: health issue assessment.** (Environmental Protection Agency, Washington, DC (USA). Office of Health and Environmental Assessment). Jul 1987. 52p. NTIS, PC A04/MF A01.

Zinc is a dense, bluish-white, relatively soft metal used extensively in the galvanizing of iron and steel. Zinc oxide, the most valued of the variety of compounds formed by zinc is used principally in rubber products as an activator in the vulcanization process and in the treatment of burns, infections, and skin diseases. Zinc occurs naturally in the environment; however, zinc may also enter the environment as the result of mining and processing the production of zinc oxide and the manufacture and use of products containing zinc oxide, the combustion of coal and oil, the production of iron and steel, and the incineration of refuse. Humans are mainly exposed to zinc through the ingestion of food (between 8 and 18.6 mg/kg/day) and drink (averaging up to 10 mg/day). Based on annual average airborne zinc concentrations in areas throughout the United States without mines or smelters of generally < 1mg/cu. m., the contribution of zinc from inhaled air represents an insignificant amount of daily zinc exposure, averaging approximately 20 micrograms. The literature on the toxic effects of zinc is limited. The most widely known systemic effect resulting from acute inhalation of freshly formed zinc oxide fumes is a disease called metal fume fever. Metal fume fever occurs in certain occupational settings and the exposure level at which the fever occurs is not known.

7917 **Inactivation of human and simian rotaviruses by ozone.** Vaughn, J.M.; Chen, Y.S.; Lindburg, K.; Morales, D. (Brookhaven National Lab., Upton, NY). *Applied and Environmental Microbiology;* 53: No. 9, 2218-2221(Sep 1987).

The inactivation of simian rotavirus Sa-11 and human rotavirus type 2 (Wa) by ozone was compared at 4°C by using single-particle virus stocks. Although the human strain was clearly more sensitive, both virus types were rapidly inactivated by ozone concentrations of 0.25 mg/liter or greater at all pH levels tested. Comparison of the virucidal activity of ozone with that of chlorine in identical experiments indicated little significant difference in rotavirus-inactivating efficiencies when the disinfectants were used at concentrations of 0.25 mg/liter or greater.

7918 **Acrylamide: induction of heritable translocations in male mice.** Shelby, M.D.; Cain, K.T.; Cornett, C.V.; Generoso, W.M. (National Institute of Environmental Health Sciences, Research Triangle Park, NC). *Environmental Mutagenesis;* 9: No. 4, 363-368(1987). Contract AC05-84OR21400.

Acrylamide (AA), known to induce dominant lethals in male rodents, was studied in the mouse heritable translocation test by using intraperitoneal injections on 5 consecutive days. Matings on days 7-10 following the last injection yielded a high frequency of translocation carriers in the $F_1$ male population, which demonstrated that acrylamide is an effective inducer of translocations in postmeiotic germ cells. As an inducer of both dominant lethals and heritable translocations in late spermatids and early spermatozoa, AA is similar to alkylating agents such as ethylmethanesulfonate and ethylene oxide. However, AA's chemical structure, the nature of adducts formed with DNA, and its lack of mutagenicity in bacteria suggest a different mechanism as the basis for AA's germ cell mutagenicity.

7919 **Effect of mode of administration of methyl methanesulfonate and triethylenemelamine on induction of unscheduled DNA synthesis in mouse germ cells.** Sheu, C.W.; Sega, G.A.; Owens, J.G. (Food and Drug Administration, Washington, DC). *Environmental Mutagenesis;* 9: No. 3, 281-288(1987). Contract AC05-84OR21400.

The effect of route of administration on induction of unscheduled DNA synthesis (UDS) in mouse germ cells in vivo was studied using two germ cell mutagens, methyl methanesulfonate (MMS) and triethylenemelamine (TEM). The chemicals were administered to male mice (C3Hf x 101)$F_1$ by IP injection or gavage using acute or 5-day subacute regimens. After completion of dosing, methyl-[$^3$H]thymidine ([$^3$H]TdR) was injected into the testes, and spermatozoa were collected 16 days later. The sperm heads were isolated, and UDS was determined by the amount of [$^3$H]TdR incorporated. Acute administration of MMS (2-100 mg/kg) induced a strong, dose-related UDS response. The response was slightly higher with IP injection than with gavage. Acute administration of TEM (0.05-4.0 mg/kg) by IP injection or gavage induced weak and variable responses. The study showed that gavage, as well as IP injection, can be used for the administration of test chemicals and that the subacute 5-day regimen induced a higher UDS response than the acute regimen. Furthermore, the testicular route may enhance the detection of weak UDS inducers.

7920 **Factors that affect the frequency of thioguanine-resistant lymphocytes in mice following exposure to ethylnitrosourea.** Jones, I.M.; Burkhart-Schultz, K.; Strout, C.L.; Crippen, T.L. (Lawrence Livermore National Lab., CA). *Environmental Mutagenesis;* 9: No. 3, 317-329(1987). Contract W-7405-ENG-48.

The frequency of thioguanine(TG)-resistant lymphocytes in mice treated with ethylnitrosourea (ENU) was followed for a period of 51 wk using the authors clonogenic assay. The effects of dose (0-58 mg/kg), time since treatment (2-51 wk), dose rate (5 weekly x 11.7 mg/kg versus 1 x 58 mg/kg), and age at time of treatment (3 vs 15 mo) on the frequency of TG-resistant, concanavalin A-responsive spleen cells were evaluated. The frequencies of TG-resistant spleen cells were generally dose responsive for 51 wk after exposure to ENU. They also were dependent upon the time that had elapsed since treatment with ENU, increasing to maximal values at 10, and holding essentially stable at values of ~20% of the maximum frequency from week 15 until at least week 40 for the 3-month-old mice. Fractionation of 58 mg ENU/kg into 5 weekly doses did not affect the frequency of ENU-induced TG-resistant cells detected in the spleen but did increase the rate of appearance in the spleen, and the efficiency of induction by the unit dose, of TG-resistant cells. The mice exposed to ENU at 15 mo of age appeared to have a 4-fold reduction in the rate of increase in frequency of ENU-induced TG-resistant spleen cells. One set of control mice was found to have a 10-fold elevated frequency of TG-resistant cells in both the spleen and thymus, indicating that mutations can occur in stem cells of untreated animals.

### 57 Health And Safety

*REFER ALSO TO CITATION(S) 7912*

## 58 GEOSCIENCES

### 5801 Geology And Hydrology

*REFER ALSO TO CITATION(S) 7234, 7408*

**7921 (TVA/ONRED/LER—87/26) Lithic raw material variability in the Central Duck River Basin: Reflections of Middle and Late Archaic organizational strategies: Report of Investigations No. 46.** Amick, D.S. (Tennessee Univ., Knoxville (USA). Dept. of Anthropology). 1987. 257p. NTIS, PC A12/MF A01. Order Number DE88900176/JAW.

The purpose was to develop a model for understanding prehistoric chipped-stone distribution in the central Duck River Basin region located in Middle Tennessee. The model design consists of theoretical and empirical observation which are integrated to form an interpretive framework. Seven lithic assemblages ranging from middle to late Archaic periods (ca. 7000 to 3000 years B.P.) in age were analyzed to assess the model. The first stage of model-building was the development of a theoretical foundation for approaching the problem. A cultural adaptation paradigm is the foundation cornerstone. Lithic technology is viewed as an integral part of prehistoric cultural adaptation and lithic remains are regarded as critical indicators of behavioral variability. Environmental variables are stressed in interpreting lithic debris patterning across the landscape. The second stage of model-building involved the construction of a set of observations on lithic resource types and their distributions in the study area. A regional lithic resource survey was implemented. Application of the model to archaeological data was the last stage of model-building. Seven Middle-Late Archaic assemblages are compared. Results of the interassemblage analysis suggest that Late Archaic settlement systems were more logisically organized and technological systems were less expediently organized than those of Middle Archaic groups. Differences between Middle and Late Archaic adaptations are viewed as response to regional environmental and demographic trends. These trends are documented and their implications for subsistence, settlement, and social organization are considered.

### 5802 Geophysics

*REFER ALSO TO CITATION(S) 7290, 7410, 7827*

**7922 (LBL—24048) The application of high frequency seismic monitoring methods for the mapping of fluid injections.** Majer, E.L. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 24p. (CONF-8704111—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002707/JAW.

From Forced flow through fractured rock masses; Garcy, France (13 Apr 1987).

This paper describes experimental work using seismic methods for monitoring the path of fluid injections. The most obvious application is the high pressure fluid injections for the purpose of hydrofracturing. Other applications are the injection of grout into shallow subsurface structures and the disposal of fluids in the geothermal and toxic waste industries. In this paper hydrofracture monitoring and grout injections will be discussed.

### 5803 Mineralogy, Petrology, And Rock Mechanics

*REFER ALSO TO CITATION(S) 7234*

### 5804 Geochemistry

*REFER ALSO TO CITATION(S) 7234, 7857*

## 64 PHYSICS I

### 6401 Astrophysics And Cosmology

*REFER ALSO TO CITATION(S) 7992*

**7923 (IPNO-TH—87-14) Equation of state of hot dense matter.** Lassaut, M.; Flocard, H.; Bonche, P.; Heenen, P.H.; Suraud, E. (Paris-11 Univ., 91 - Orsay, France. Institut de Physique Nucleaire; CEA CEN Saclay, 91 - Gif-sur-Yvette, France. Service de Physique Theorique; Univ. Libre de Brussels, Belgium; I.S.N., 38 - Grenoble, France). (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751400/JAW.

With the Thomas-Fermi method, we determine the equation of state of hot dense matter at nuclear subsaturation densities. We investigate several geometries with nucleons organized in cristals structures of nuclei, rods, slabs, tubes and bubbles. We calculate the adiabatic index relevant for the first stage of the collapse of medium stars.

**7924 (LA-UR—87-3356) Numerical modelling of the classical nova outburst.** Kutter, G.S.; Sparks, W.M. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 3p. (CONF-8709186—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001843/JAW.

From IAU colloquium No. 108; Tokyo, Japan (1 Sep 1987).

We describe a mechanism that promises to explain how nova outbursts take place on white dwarf of 1 Msub solar or less and for accretion rates of $4 \times 10^{-10}$ Msub solar $yr^{-1}$ or greater. 7 refs.

**7925 (LA-UR—87-3519) Bidirectional electron heat flux events in space.** Bame, S.J.; Gosling, J.T. (Los Alamos National Lab., NM (USA)). 1986. Contract W-7405-ENG-36. 22p. (CONF-8611203—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001791/JAW.

From Tokyo plasma workshop; Tokyo, Japan (1 Nov 1986).

In this paper we discuss a number of space plasma phenomena which have been illuminated by a powerful diagnostic tool provided by tracing heat flux carried by the solar wind. Measurements of this flow of heat energy from the sun and other hot plasma regions have been employed to increase our understanding of the solar wind interaction with solar system objects. Similarly, anomalies in the heat flux have helped to explain unusual plasma entities which are sometimes found in the interplanetary solar wind. The heat flux is principally carried by the solar wind electrons, since they are much more mobile than the ions. The electrons conduct heat outward from the hot solar corona and in a sense they constitute test particles that trace out the various plasma structures found in the solar wind and in the vicinities of bodies immersed in the interplanetary plasma flow. In the following sections we begin by discussing the electron heat flux which flows outward from the solar corona. This flux is ordinarily found flowing in one direction, i.e., it is unidirectional. Sometimes it is observed counterstreaming, i.e., it is bidirectional. In later sections we discuss how detection of bidirectional heat fluxes has contributed to a more complete understanding of the Earth's bow shock, the bow wave at Comet Giacobini-Zinner, interplanetary plasma structures injected into the solar wind by solar activity processes, and finally polar rain electrons that are found precipitating over the Earth's poles but are believed to originate in the hot solar corona. 37 refs., 16 figs.

**7926 (LAPP-TH—185-87) Unstable light particles and thermal evolution of the universe - 10 < Z < 10/sup 3/.** Asselin, X.; Girardi, G.; Salati, P.; Blanchard, A. (Grenoble Univ., 74 - Annecy-le-Vieux, France. LAPP; Observatoire de Paris, 92 - Meudon, France). (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Feb 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751420/JAW.

In this paper we investigate an appealing scenario where the universe is filled with light radiatively unstable particles. Depending on their lifetime the thermal history of the universe since the hydrogen recombination may be drastically changed. In particular for plausible lifetime tau >~ 10/sup 24/s, the intergalactic medium is fully ionised. This in turn lowers the level of detectable temperature fluctuation of the 3/sup 0/K fossil radiation a case in favour of galaxy formation in the presence of warm dark matter.

**7927 (LBL—23924) Primordial nucleosynthesis during the keV era.** Dimopoulos, S.; Esmailzadeh, R.; Hall, L.J.; Starkman, G.D. (Stanford Univ., CA (USA); Lawrence Berkeley Lab., CA (USA)). 9 Sep 1987. Contract AC03-76SF00098. 5p. (CONF-8708165—2). NTIS, PC A02. Order Number DE88002233/JAW.

From Symposium on the origin and distribution of elements; New Orleans, LA, USA (31 Aug 1987).

Energetic hadronic and electromagnetic showers in the keV era of the hot big bang are produced by the decays of long lived particles. These showers initiate a new phase of nucleosynthesis. The abundance ratios of D, $^3$He, $^6$Li and $^7$Li are given by fixed points of rate equations, which are determined by nuclear physics not by the nature of the decaying particle. The fixed points are independent of prior abundances, so that constraints from the MeV era of nucleosynthesis evaporate, except for a requirement that $^4$He not be underproduced. For example, Ω/sub B/ = 1 and many more than four neutrino species are both possible. Within the accuracy of our calculation (there are uncertainties of at least a factor of three), the abundances agree with those inferred from observations. Considerable $^6$Li is produced and must be depleted in both population II halo stars and in the galactic disk. We predict $^6$Li, $^3$He and D abundances in primordial material which are higher than conventional nucleosynthesis. 8 refs.

**7928 (N—87-28625) Submillimeter and far-infrared spectroscopy of M17 and S106: UV-heated, quiescent molecular gas?.** Harris, A.I.; Stutzki, J.; Genzel, R.; Lugten, J.B.; Stacey, G.J.; Jaffe, D.T. (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.)). Apr 1987. 25p. (NASA-CR—181364; NAS—1.26:181364; MPE-PREPRINT—87; ETN—87-90567). Issuing Activity.

Measurements of CO line emission toward the interface between molecular cloud and HII region in M17, and the center of the bipolar nebula S106 are discussed. The warm quiescent molecular gas is in the interface between the exciting OB stars and the surrounging molecular cloud. Comparison of the submillimeter, far-IR, and millimeter CO line intensities and profiles suggests a model in which clumps of relatively cool gas (T = 50 K) have warm surfaces or are embedded in a warm surrounding medium. Heating of the warm, quiescent molecular gas by collisions with dust grains can be excluded. Slow shocks or heating by photoelectrons are possible. The most promising mechanism is photoelectric heating. The existence of a substantial amount of warm, quiescent molecular gas in UV illuminated regions may be of importance locally in most OB star formation regions and globally in external galaxies with large rates of star formation.

**7929 (N—87-29391) Physical conditions, dynamics and mass distribution in the center of the galaxy.** Genzel, R.; Townes, C.H. (Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany, F.R.)). Apr 1987. 72p. (NASA-CR—181363; NAS—1.26:181363; MPE-PREPRINT—86; ETN—87-90566). Issuing Activity.

Investigations of the central 10 pc of the Galaxy, and conclusions on energetics, dynamics, and mass distribution derived from x and gamma ray measurements and from infrared and microwave studies, especially from spectroscopy, high resolution imaging, and interferometry are reviewed. Evidence for and against a massive black hole is analyzed.

**7930 (N—87-29395) Origin of channels and associated deposits in the Elysium region of Mars. Final technical report, January 1984-June 1987.** Christiansen, E.H.; Hoppin, R.A. (Brigham Young Univ., Provo, UT (USA)). Sep 1987. 92p. (NASA-CR—181345; NAS—1.26:181345). NTIS, PC A05/MF A01.

Photogeological studies of the Elysium volcanic province of Mars show that its sinuous channels are part of a large deposit which probably was emplaced as a series of huge volcanic debris flows or lahars. The suggestion is based on evidence that the lahars were : (1) gravity-driven mass flow deposits (lobate outlines, steep snouts, smooth medial channels and rough lateral deposits--the deposits narrow and widen in accord with topography, and they extend downslope); (2) wet (channeled surfaces, drainage features); and (3) associated with volcanism (the deposits and channels extend from a system of fractures which fed lava flows). It is conceivable that heat associated with magmatism melted ground ice below the Elysium volcanoes, formed a muddy slurry which issued out of regional fractures and spread over the adjoining plain.

**7931 (N—87-29967) Improved model of the Earth's gravitational field: GEM-T1.** Marsh, J.G.; Lerch, F.J.; Christodoulidis, D.C.; Putney, B.H.; Felsentreger, T.L.; Sanchez, B.V.; Smith, D.E.; Klosko, S.M.; Martin, T.V.; Pavlis, E.C. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jul 1987. 351p. (NASA-TM—4019; REPT—87B0451; NAS—1.15:4019). NTIS, PC A16/MF A01.

Goddard Earth Model T1 (GEM-T1), which was developed from an analysis of direct satellite tracking observations, is the first in a new series of such models. GEM-T1 is complete to degree and order 36. It was developed using consistent reference parameters and extensive earth and ocean tidal models. It was simultaneously solved for gravitational and tidal terms, earth orientation parameters, and the orbital parameters of 580 individual satellite arcs. The solution used only satellite tracking data acquired on 17 different satellites and is predominantly based upon the precise laser data taken by third generation systems. In all, 800,000 observations were used. A major improvement in field accuracy was obtained. For marine geodetic applications, long wavelength geoidal modeling is twice as good as in earlier satellite-only GEM models. Orbit determination accuracy has also been substantially advanced over a wide range of satellites that have been tested.

**7932 (N—87-30232) Origin and transport of high energy particles in the galaxy. Final technical report, 1 March 1984-28 February 1987.** Wefel, J.P. (Pennsylvania Univ., Philadelphia (USA). Center for Chemical Engineering). Feb 1987. 21p. (NASA-CR—181368; NAS—1.26:181368). NTIS, PC A02/MF A01.

The origin, confinement, and transport of cosmic ray nuclei in the galaxy was studied. The work involves interpretations of the existing cosmic ray physics database derived from both balloon and satellite measurements, combined with an effort directed towards defining the next generation of instruments for the study of cosmic radiation. The shape and the energy dependence of the cosmic ray pathlength distribution in the galaxy was studied, demonstrating that the leaky box model is not a good representation of the detailed particle transport over the energy range covered by the database. Alternative confinement methods were investigated, analyzing the confinement lifetime in these models based upon the available data for radioactive secondary isotopes. The source abundances of several isotopes were studied using compiled nuclear physics data and the detailed transport calculations. The effects of distributed particle acceleration on the secondary to primary ratios were investigated.

**7933 (N—87-30235) Atlas of Comet Halley 1910 II.** Donn, B.; Rahe, J.; Brandt, J.C. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). 1986. 597p. (NASA-SP—488; NAS—1.21:488; LC—86-16341). SOD HC $48.00 as 033-000-00991-7; NTIS MF A01.

With the impending return of Halley's Comet in 1986, a major effort began to collect the material obtained at its last ap-

pearance in 1910. This material displays the evolving coma and tail phenomena, and is useful for comparison with the present quantitative studies of spectroscopic and structural phenomena. Images in the atlas are arranged in chronological order by day. Days that have multiple images with varying scale are arranged in two sequences. Photographs showing tail phenomena are first, followed by photographs obtained with longer focus instruments showing the head or near-nuclear region. Drawings of Comet Halley, made from visual observations in 1835 and 1910, also are included.

7934 **(N—87-30239) Determination of hydrogen abundance in selected lunar soils. Final technical report, 1 June-31 October 1987.** Bustin, R. (Arkansas Coll., Batesville (USA)). Oct 1987. 42p. (NASA-CR—181408; NAS—1.26:181408). NTIS, PC A03/MF A01.

Hydrogen was implanted in lunar soil through solar wind activity. In order to determine the feasibility of utilizing this solar wind hydrogen, it is necessary to know not only hydrogen abundances in bulk soils from a variety of locations but also the distribution of hydrogen within a given soil. Hydrogen distribution in bulk soils, grain size separates, mineral types, and core samples was investigated. Hydrogen was found in all samples studied. The amount varied considerably, depending on soil maturity, mineral types present, grain size distribution, and depth. Hydrogen implantation is definitely a surface phenomenon. However, as constructional particles are formed, previously exposed surfaces become embedded within particles, causing an enrichment of hydrogen in these species. In view of possibly extracting the hydrogen for use on the lunar surface, it is encouraging to know that hydrogen is present to a considerable depth and not only in the upper few millimeters. Based on these preliminary studies, extraction of solar wind hydrogen from lunar soil appears feasible, particulary if some kind of grain size separation is possible.

7935 **(N—87-30243) Very high resolution UV and x-ray spectroscopy and imagery of solar active regions. Final report.** Bruner, M.; Brown, W.A.; Haisch, B.M. (Lockheed Missiles and Space Co., Inc., Sunnyvale, CA (USA)). 1987. 63p. (NASA-CR—168352; NAS—1.26:168352). NTIS, PC A04/MF A01.

A scientific investigation of the physics of the solar atmosphere, which uses the techniques of high resolution soft x-ray spectroscopy and high resolution UV imagery, is described. The experiments were conducted during a series of three sounding rocket flights. All three flights yielded excellent images in the UV range, showing unprecedented spatial resolution. The second flight recorded the x-ray spectrum of a solar flare, and the third that of an active region. A normal incidence multi-layer mirror was used during the third flight to make the first astronomical x-ray observations using this new technique.

7936 **(N—87-30245) NASA's solar maximum mission: a look at a new Sun.** Gurman, J.B. (National Aeronautics and Space Administration, Greenbelt, MD (USA). Goddard Space Flight Center). Jun 1987. 48p. (NASA-TM—89539; NAS—1.15:89539). NTIS, PC A03/MF A01.

As part of the ongoing process of trying to understand the physical processes at work in the Sun, the Solar Maximum Mission (SMM) spacecraft was launched on February 14, 1980, near the height of the solar cycle, to enable the solar physics community to examine, in more physically meaningful detail than ever before, the most violent aspect of solar activity: flares. The scientific products of SMM are substantial: by 1986, over 400 papers based on SMM observations and their interpretations had appeared in scientific journals. More important than such numerical measures of success is the significance of the science that has come from SMM. The following topics, the Sun as a star, solar flares, and the active solar atmosphere, as well as other findings of SMM investigators are described. The instruments on the SMM are also described.

7937 **(PB—88-101274/XAB) Solar-geophysical activity reports for STIP (study of travelling interplanetary phenomena) Interval 15, 12-21 February 1984 ground-level event and STIP Interval 16, 20 April-4 May 1984 Forbush decrease.** Coffey, H.E.; Allen, J.H. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Jul 1987. 418p. (UAG—96). NTIS, PC A18/MF A01.

See also report dated February 1982, PB—82-230558.

Contents include: solar-geophysical activity reports for STIP Interval XV 12-21 February 1984 ground-level event and STIP interval XVI 20 April-4 May 1984 Forbush decrease; overview of solar-terrestrial physics phenomena for STIP interval XV (12-21 February 1984) and STIP interval XVI (20 April-4 May 1984) (solar optical reports, solar radio events, spacecraft observations, cosmic ray observations, ionosphere, geomagnetism).

7938 **(PB—88-102132/XAB) Short-term temporal variations of NIMBUS-7 measurements of the solar uv spectral irradiance. Technical memo.** Donnelly, R.E.; Stevens, D.E.; Barrett, J.; Pfendt, K. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jun 1987. 64p. (NOAA-TM-ERL-ARL—154). NTIS, PC A04/MF A01.

NIMBUS-7 measurements of the solar spectral irradiance in the 160-400 nm range during November 7, 1978 - October 29, 1984, were analyzed to determine the characteristics of their short-term variations (days and weeks to a couple of months). The persistence of solar-rotational variations is shown to be uniformly high for the UV wavelengths important for inducing stratospheric photochemical reactions and for heating the stratosphere, which contrasts greatly with the low and nonuniform persistence for coronal EUV wavelengths and the standard ground-based measures of solar variability, the Ottawa 10.7-cm flux (F10) and sunspot number (R). Periodicity in the 13 - 14 day range is the second strongest short-term variation (27 - 28 day solar rotational variations are the strongest short-term periodicity). The ratios of power in the 13-day periodicity to that in the 27-day periodicity is fairly constant for photospheric UV fluxes throughout the 170 - 260 nm wavelength range, the main exception being the chromospheric Si II lines in the 180 - 182 nm range.

7939 **Lectures on particle physics and cosmology.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL 60510). pp 444-464 of Superstrings, supergravity and unified theories. Furlan, G.; Jengo, R.; Pati, J.C.; Sciama, D.W.; Shafi, Q. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506324—).

From Summer workshop on high energy physics and cosmology; Trieste, Italy (10 Jun 1985).

This paper compiles the lectures given in the 1985 ICTP High Energy Physics and Cosmology Workshop. The three topics discussed are: I) Generation of a Cosmological Baryon Asymmetry, II) Extra Dimensions and Cosmology, and III) The Sage of Cygnus X-3.

## 6402 Atmospheric Physics

*REFER ALSO TO CITATION(S) 7937, 8303*

7940 **(AD-A—184509/8/XAB) Comparative analysis of equatorial and auroral-zone phase scintillation data. Technical report, 13 March 1985-30 September 1986.** Rino, C.L.; Dabbs, T.M. (SRI International, Menlo Park, CA (USA)). 1 Oct 1986. 74p. NTIS, PC A04/MF A01.

A comparison is made between equatorial and auroral-zone phase scintillation. The spectral characteristics of weak-scatter phase-scintillation data collected at two equatorial ground stations are contrasted with similar data collected at two auroral-zone ground stations. An automated, multisegmented fitting procedure was used to determine these characteristics. Three types of spectra were found. Despite temporal and spatial differences, the two equatorial data sets have similar spectral characteristics. The auroral-zone sets are also similar. In contrast, the spectral characteristics of the two latitude regions are quite different from each other.

7941 **(N—87-29984) Plasmasphere and magnetosphere structure from ISEE-1 and DE-1. Final report.** Olsen, R.C. (Alabama Univ., Huntsville (USA)). Oct 1987. 31p. (NASA-CR—181372; NAS—1.26:181372). NTIS, PC A03/MF A01.

The density structure of the plasmapause region was investigated using the two satellites, ISEE-1 and DE-1 to obtain complementary radial and latitudinal profiles. Data from the plasma wave

receivers were to be used to obtain total electron density, and from the ion mass spectrometers to determine thermal plasma morphology.

7942 **(PB—88-104450/XAB) Wave acceleration of auroral electrons.** Bryant, D.A. (Rutherford Appleton Lab., Chilton (UK)). Jun 1987. 10p. (RAL—87-044). NTIS, PC E03/MF E03.

It has become increasingly evident that the complex plasma processes taking place in the aurorae cannot be understood without due consideration of the full range of properties of the plasma state. It was such philosophy that brought double layers and anomalous resistivity, well known in the laboratory, into play to try to account for the acceleration of magnetospheric electrons from a few keV to 10 keV or more, resulting in auroral arcs and other forms of aurora. It is now widely realized that models based on these processes alone, or indeed on any ordered form of acceleration, have serious limitations. The recent progress in developing a quantative model of electron acceleration by lower-hybrid waves, arising as an instability in magnetospheric ion streams, is reported. Endorsements from simulation studies are presented, and applications in other areas of space plasma physics are identified.

7943 **(UCID—21204) TRACKER: A 3-D radio ray tracing code.** Carlson, R.E.; Ellison, J.H. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003267/JAW.

TRACKER is a 3-D radio ray tracing code which has been designed to simulate high frequency radio wave propagation through a perturbed ionosphere. It is the centerpiece of a family of codes written for the Cray-1 computer whose purpose is to model radar systems for use in detecting and identifying ionospheric perturbations. TRACKER accepts as input a perturbation file that describes the shape of an acoustic pulse at a discrete set of points in space at various times since the pulse was initiated. Except for a sophisticated set of interpolation algorithms needed to approximate the pulse shape at an arbitrary point, the perturbation model is external to TRACKER. The features that distinguish TRACKER from other ray tracing codes are the physics models, the state-of-the-art computational algorithms, the structure and modularity of the code itself, the interactive operational mode, and the sophisticated graphical output.

7944 **ISEE-3 plasma measurements in the lobes of the distant geomagnetic tail: Inferences concerning reconnection at the dayside magnetopause.** Gosling, J.T. (Los Alamos National Lab., Los Alamos, NM 87545). pp 157-158 of Magnetic reconnection in space and laboratory plasma. Hones, E.W. Washington, DC; American Geophysical Union (1984). (CONF-8310229—).

From Chapman conference on magnetic reconnection; Los Alamos, NM, USA (3 Oct 1983).

The lobes of the geomagnetic tail are the regions located north and south of the plasma sheet and extending to the magnetopause. It is commonly believed that lobe field lines are "open," one end of a lobe field line being rooted in the ionosphere and the other end being connected to the interplanetary magnetic field. This picture necessarily assumes that reconnection at least occasionally occurs at the dayside magnetopause, lobe field lines being reconnected field lines which have been dragged back into the tail by the flow of the solar wind. The question of whether the local tail magnetopause is open or closed depends upon reconnection at the dayside magnetopause and the recent polarity of the y component of the interplanetary magnetic field. Reconnected field lines are pulled preferentially toward the dawn side of the tail across the northern polar cap, and toward the dusk side of the tail across the southern polar cap. Thus when the y-component of the interplanetary field is positive, one expects to find the magnetopause adjacent to the northern lobe to be open preferentially on the dawn side of the tail and closed on the dusk side of the tail.

## 6403 Atomic, Molecular, And Chemical Physics

*REFER ALSO TO CITATION(S) 7689, 7963, 8130, 8202, 8300, 8302*

7945 **(AD-A—184536/1/XAB) Multiphoton ionization studies of xenon clusters.** Echt, O.; Cook, M.C.; Castleman, A.W. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 3 Apr 1987. 6p. NTIS, PC A02/MF A01.

Pub. in Chemical Physics Letters, Vol. 135, No. 3, 229-235(3 Apr 1987).

Non-resonant multiphoton ionization of xenon clusters has revealed the same magic numbers as found in the case of electron-impact ionization. Large dissociation rates are found for the trimer through pentamer ion, measured on a time scale of approx $10^{-7}$ s after ionization.

7946 **(AD-A—184670/8/XAB) Role of core size in the photoelectron spectrum of ions with multiple detachment orbitals. Semi-annual report, 1 July-31 December 1986.** Stehman, R.M.; Woo, S.B. (Delaware State Coll., Dover (USA). Dept. of Physics and Astronomy). Oct 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 34, No. 4 3rd series, 2585-2590(Oct 1986).

The zero-core-contribution model is used to calculate the photoelectron spectra of three anions with complex electron configurations: $Sc^-$, $Y^-$, and $Pd^-$. Electrons can be detached from s, p, and d shells in $Sc^-$, and $Y^-$. Detachment occurs from s and d shells in $Pd^-$, which is further complicated by having bound states with two different electron configurations. The complex electron configurations of all these ions result in a variety of peaks with widely different intensities within each spectrum. The intensities of these peaks are accounted for by the zero-core-contribution model. The spectrum of $Pd^-$ provides a unique test of the rule for determining the core radius given in previous papers using this model.

7947 **(AD-A—184774/8/XAB) Theoretical study of Ca(4s5p 1p) yields Ca(4s5p 3p) transitions in collisions with He: integral cross sections and alignment effects.** Pouilly, B.; Alexander, M.H. (Maryland Univ., College Park (USA). Dept. of Chemistry). 1 May 1987. 12p. NTIS, PC A03/MF A01.

Pub. in Jnl. Chemical Physics, Vol. 86, No. 9, 4790-4800(1 May 1987).

The fully quantum theory is developed for 1P to 3P transitions in collisions of electronically excited (nsn'p) alkaline earth atoms with closed-shell atoms. Spin-changing transitions occur by means of the small spin-orbit mixing between the 1P and 3P sub(j=1) states of the isolated atom, and are facilitated by the crossing between the 1 Pi and 3 Sigma potential curves which are carried out for the Ca(4s5p) + He system, based on four different choices of the necessary interaction potentials. Particular attention is devoted to the simulation of the recent experiment of Hale, Hertel, and Leone Phys. Rev. Lett. 53, 2296 (1984), in which the 1P and 3P cross section was determined in a crossed-beam experiment as a function of the orientation of the initially excited 5p orbital. This polarization dependence depends critically on the long-range splitting between the 1 Pi and 3 Sigma curves. A fully adiabatic description of the collision dynamics is used to interpret the results of the quantum-scattering calculations. No clear-cut theoretical justification is found for the orbital-following models that have been developed to interpret prior experimental studies of collisions involving excited atoms in P electronic states. Rather, a picture emerges in which the initially selected orientation of the Ca p orbital correlates, at short range, with equal probability to Sigma-like and Pi-like potential curves. Variations in the 1P to 3P cross sections are due to long-range Coriolis coupling between the electronic orbital and nuclear orbital momenta and may reflect quantum interference effects between the Pi-like and Sigma-like adiabatic potentials.

7948 **(CONF-8710200—1) Extensions to the two atom blocking model.** Oen, O.S. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001771/JAW.

From Theoretical (computational) symposium on atomic collisions in solids; Tokyo, Japan (7 Oct 1987).

This paper contains viewgraphs on the use of the blocking model to describe atom-atom collisions in solids. Experimental results on two particle emissions for attractive and repulsive coulomb potentials are given. (LSP)

7949 **(DOE/ER/02197—97) Hadronic atoms: Technical progress report, February 1, 1985-January 31, 1986.** Kunselman, R. (Wyoming Univ., Laramie (USA)). 1986. Contract AC02-76ER02197. 7p. (COO—2197-97). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001712/JAW.

The main efforts on hadronic atoms for 1984 have been on experiments at TRIUMF, BNL, and LAMPF. The experiments have involved atoms with pions, kaons, and sigma-minus particles. In particular, x-ray spectra measurements are made of pionic atoms of lead, bismuth, sodium, manganese, iron, nickel and cobalt isotopes. X-ray spectra measurements of kaonic and sigma-minus hydrogen are also discussed. (LSP)

7950 **(DOE/ER/02197—100) Hadronic atoms and leptonic conservations: Technical progress report, February 1, 1986-January 31, 1987.** Kunselman, R. (Wyoming Univ., Laramie (USA)). 1987. Contract AC02-76ER02197. 8p. (COO—2197-100). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001605/JAW.

The 1985 efforts on hadronic atoms have been on the experiments at TRIUMF, BNL, and LAMPF. The experiments have involved atoms with pions, kaons, and sigma-minus particles. The efforts on leptonic conservations have been on the experiments at TRIUMF and LAMPF. In particular, this paper discusses experiments on the stopping of pion minus in a phosphorus target, pionic atoms of lead-208 and bismuth-209, violations of lepton flavor in the reaction $\mu^+ + e^- \rightarrow \mu^- + e^+$, and rare muon decay. (LSP)

7951 **(DOE/ER/13237—T3) [Low energy ion-neutral collisions]: Final technical report.** (Missouri Univ., St. Louis (USA)). 1987. Contract FG02-84ER13237. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002381/JAW.

The emphasis in this program was to examine energy partitioning among the available final states resulting from atomic and molecular interactions. In particular, this paper briefly discusses excitation transfer and associative ionization in sodium-sodium collisions, ion production of sodium resulting from heavy body collisions with sodium Rydberg atoms, photoionization of sodium and laser induced processes. (LSP)

7952 **(GSI—85-26) Characteristic X-ray emission in close collisions between heavy ions and atoms.** Warczak, A. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Uniwersytet Jagiellonski, Krakow (Poland)). Dec 1985. 92p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751276/JAW.

In this paper an attempt is given to answer the question of how far the inner-shell vacancy production in very heavy ion-atom collisions is influenced by the electronic configuration of the projectile prepared prior to the collision producing the observed vacancy. The variation of this configuration has been induced by changing the primary charge state of the projectile, the target density and thickness or by inverting the collision system. It turns out from the performed analysis of the experimental data that the excitation of even most strongly bound MO's can be easily dependent on these factors which have been ignored until now, especially in discussions of the $1s\sigma$ or $2p\sigma$ vacancy production at Z/sub UA/ > 130. Experiments performed for the first time with gaseous targets for such heavy systems show very convincingly the influence of the outer-shell configuration on the vacancy production in inner shells. The analysis of the data has been performed in terms of electronic transitions among MO's transiently formed during the collision. In many cases a satisfactory agreement between theoretical predictions and experiment has been achieved. (orig./HSI).

7953 **(INIS-SU—431, pp 218) Effects of nuclear structure on hyperfine structure of atomic spectra.** Kolesnikov, N.N.; Starosotnikov, M.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

7954 **(INIS-SU—431, pp 227) Effect of X-ray line shift in atoms with oriented nuclei.** Batkin, I.S.; Churakova, T.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

7955 **(INIS-SU—431, pp 219) Effect of nuclear quadrupole moment on hyperfine structure of muonic atom ground state.** Trofimenko, E.E.; Tesevich, B.I.; Kuzhir, P.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

7956 **(LYCEN-T—8680) Photoelectron spectroscopy study and inverse photoemission study of amorphous binary metallic alloys.** Martin, M. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Dec 1986. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751425/JAW.

Amorphous copper - yttrium and palladium - yttrium alloys are studied by photoemission and inverse photoemission. The electronic structure of these alloys is described by the interaction of s, p and d valence electrons. A complete view of the total density of occupied and unoccupied electronic states has been obained thanks to combined photoemission and inverse photoemission measurements. The structures and the evolution of the valence bands with alloying agree well with an sp and d hybridization model. The core level shifts are also explained by this model, the Fermi level being shifted with the deformation of the electronic bands with hybridization, without using interatomic charge transfer. Short range order, or chemical order is considered and its possible influence on the electronic structure is examined with the help of recent valence band calculations. An increasing chemical order (i.e. a preferential attraction between the constituents) is found for rich copper alloys.

7957 **Autler-Townes effect in hydrogen at low pressure.** Lau, A.M.F. (Sandia National Labs., Livermore, CA, USA). *changed to JPAMA;* **20**: No. 15, L469-L473(14 Aug 1987).

The author investigates the Autler-Townes effect (also known as AC, optical or dynamical Stark splitting) on the Balmer-$\alpha$ transition of hydrogen in 0.5-5 Torr of helium. In the double optical resonance scheme, H(3p) is excited by absorption of two 243 nm photons and a 656 nm photon via the 2s resonant intermediate level. Calculated results show that in a Doppler-free or a 'Doppler-reduced' beam configuration, the required intensity of the 656 nm laser for observation of the Autler-Townes doublet has to be greater than 2 x 10/sup 4/ and 2 x 10/sup 5/ W cm/sup -2/ for 243 nm laser bandwidths of 0.1 and 0.5 cm/sup -1/, respectively.

7958 **Isotopic dependences of the dielectric strength of gases -new observations, classification, and possible origins.** Christophorou, L.G.; Rodrigo, H.; Marode, E.; Bastien, F. (Oak Ridge National Lab., TN, USA; Ecole Superieure d'Electricite, 91 - Gif-sur-Yvette, France. Lab. de Physique des Decharges). *changed to JPAPB;* **20**: No. 8, 1031-1038(14 Aug 1987).

The paper concerns the isotopic dependences of the dielectric strength of gases. Earlier results on H/sub 2//D/sub 2/, NH/sub 3//ND/sub 3/ and CH/sub 4//CD/sub 4/, with positive polarity are summarised, and new results on CH/sub 4//CD/sub 4/ with negative polarity are presented. The possible origins of the observed isotope effects are discussed, and new isotopic dependences of the breakdown voltages (Vs) are predicted. Results are also pre-

sented on the Vs of H/sub 2/S and D/sub 2/S for negative polarity, which confirm their predicted isotopic behaviour.

7959 **Quantal study of differential cross sections for double charge transfer in $C^{4+}$-He collisions.** Tan, J.; Lin, C.D.; Kimura, M. (Kansas State Univ., Manhattan, USA. Dept. of Physics; Argonne National Lab., IL, USA). *Journal of Physics B: Atomic and Molecular Physics;* **20**: No. 3, L91-L97(14 Feb 1987).

Differential cross sections for the double charge transfer process in $C^{4+}$-He collisions are studied using a quantal two-channel molecular orbital close coupling expansion method. The calculated results for $C^{4+}$ at incident energies of 1520 and 500 eV are found to be in good agreement with recent measurements. It is also shown that the quantal calculations and the experimental results are well reproduced by a semiclassical approximation. A comparison with a recent semi-empirical study of the same system by previous workers is also discussed.

## 6404 Fluid Physics

*REFER ALSO TO CITATION(S) 8297, 8298, 8299, 8301, 8302, 8363*

7960 **Formalism in radiative transfer.** Kunasz, P. pp 3-36 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Over the past ten years, work in radiative transfer has paralleled the development of the digital computer. Numerical solutions have been found for a set of problems of increasing physical complexity. In this paper methods for the solution of the transfer equation are reviewed, with an emphasis on methods of approximation which might be useful for complicated problems which arise in the interpretation of spectra from hot dense plasmas.

7961 **Benchmark problems for radiative transfer methods.** Lee, R.W.; Salter, J.M. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA 94550). pp 37-57 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—). Contract W-7405-ENG-48.

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Two problems addressed during the Conference on Radiative Properties of Hot Dense Matter were: the applicability of the numerical techniques for radiative transfer developed in astrophysics to laboratory plasmas; and, the lack of contact between various groups working on radiative transfer in laboratory plasmas. A simple solution to these problems is to define benchmarks which can both test numerical schemes and form the basis of contact for researchers.

7962 **Influence of strongly coupled plasmas on photoionization cross sections.** Cauble, R.; Blaha, M.; Davis, J. (Berkeley Research Associates, Springfield, VA 22151). pp 195-209 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

The authors examine the cross sections for ground state photoionization in strongly coupled neon plasmas. The calculations are made using an effective electron-ion potential, which is a result of a self-consistent quantum-mechanical formalism similar to one used previously to study high-Z impurities in hydrogen plasmas. The validity of this model in the strongly coupled plasma regime is tested by comparing the results with those developed from the two-component plasma hypernetted chain approximation, which has previously been shown to provide accurate representations of plasma screening in these systems. The results indicate that the self-consistent model remains accurate even for plasmas with $\Gamma$ of order five. The cross sections found from these methods are compared with those found from standard models.

7963 **The density dependence of dielectronic satellites of helium-like transitions.** Kilkenny, J.D.; Lee, R.W.; Whitten, B.L.; Mac Gowan, B.J.; Bradley, D.K. (The Blackett Lab., Imperial College of Science and Technology, London SW7 2BZ). pp 451-475 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

A generalized rate equation code is used to predict the ratios of the dielectronic satellites of the helium-like 1/sup 1/S - 2/sup 1/P transition in ions from Sodium to Argon. It is shown that these elements are useful for density diagnosis at electron densities between 3 x 10/sup 21/ cm/sup -3/ and 4 x 10/sup 23/ cm/sup -3/ respectively. Their use is illustrated by time-resolved and time integrated measurements on Na, Si, Ciota and Ar plasmas.

7964 **Equation of state of strongly coupled plasma mixtures.** De Witt, H.E. (Univ. of California, Lawrence Livermore National Lab., Livermore, CA 94550). pp 501-518 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—). Contract W-7405-ENG-48.

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Thermodynamic properties of strongly coupled (high density) plasmas of mixtures of light elements have been obtained by Monte Carlo simulations. For an assumed uniform charge background the equation of state of ionic mixtures is a simple extension of the one-component plasma EOS. More realistic electron screening effects are treated in linear response theory and with an appropriate electron dielectric function. Results have been obtained for the ionic pair distribution functions, and for the electric microfield distribution.

7965 **Quantum microfield distributions.** Boercker, D.B.; Dufty, J.W. (Lawrence Livermore Lab., Univ. of California, Livermore, CA 94550). pp 583-609 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

This distribution of electric fields at a neutral point is calculated for a weakly coupled one component plasma at arbitrary degeneracy. The electric field distribution is represented in terms of a quantum cluster expansion generalizing the Baranger-Mozer expansion in the classical case. The part of the series due to exchange correlations in the absence of interactions is summed to closed form. The residual part of the series is truncated after the second term, as is appropriate to lowest order in the plasma parameter. The radial distribution function in the two-body cluster integral is evaluated in the random phase (chain approximation). For asymptotically weak degeneracy the Baranger-Mozer microfield distribution (Debye-Huckel approximation) is regained. As the degeneracy is increased at fixed plasma parameter, the peak of the distribution is shifted toward smaller fields.

7966 **Magnetic reconnection in Doublets.** Jensen, T.H. (P.O. Box 85608, San Diego, CA 92138). pp 356 of Magnetic reconnection in space and laboratory plasma. Hones, E.W. Washington, DC; American Geophysical Union (1984). (CONF-8310229—).

From Chapman conference on magnetic reconnection; Los Alamos, NM, USA (3 Oct 1983).

Doublet is a magnetic configuration with the prospect of being able to confine plasmas for thermonuclear fusion. Because of

this prospect Doublet research was carried out at GA for a number of years. The Doublet configuration is axisymmetric and it employs a strong toroidal magnetic field. The poloidal magnetic field forms one hyperbolic magnetic axis located in the midplane and two elliptic axes above and below the midplane. Thus a separatrix with a cross sectional shape of a figure "8" is formed. Experimentally, Doublets were found subject to two sudden, mostly axisymmetric deformations. During one of these the plasma split into two separate plasmas, each with one elliptic axis much like two separate tokamak plasmas. During the other the three magnetic axes tended first to merge at the midplane and secondly the plasma became unstable toward motion either up or down. These deformations involve magnetic reconnections. In the first, field lines which initially link all three magnetic axes reconnect to link only one of the elliptic magnetic axes while the reverse is true for the second type of deformation.

**7967 Laboratory experiments on current sheet disruptions, double layers, turbulence and reconnection.** Gekelman, W.; Stenzel, R. (Dept. of Physics, Univ. of California, Los Angeles, CA 90024). pp 355 of Magnetic reconnection in space and laboratory plasma. Hones, E.W. Washington, DC; American Geophysical Union (1984). (CONF-8310229—).

From Chapman conference on magnetic reconnection; Los Alamos, NM, USA (3 Oct 1983).

Laboratory plasmas offer a unique opportunity to study the interaction of magnetic fields with plasmas. In particular, the diffusion region of the reconnection problem can be properly modeled since its scale length is much smaller than that of the entire convection region. Whereas in space, it is difficult to locate and analyze the field reversal region, in the laboratory one can perform repeated insitu measurements of fields, particles and waves with high resolution in time and space. Such experiments are presently being performed at UCLA. Since the major results have been presented in recent publications this extended abstract serves to summarize the findings and to point out the relevant references.

**7968 The effects of radial counterflow on rotating He II.** Campbell, L.J. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 62-63 of The 75th jubilee conference on helium-4. Armitage, J.G.M. Teaneck, NJ; World Scientific Pub. Co. (1983). (CONF-8308233—).

From 75. jubilee conference on helium - 4; St. Andrews, UK (1 Aug 1983).

Superfluid helium in a rotating container forms a uniform array of vortex lines parallel to the axis of rotation. How well can this array resist distortion and compression when additional, non-rotational flow fields are imposed? Are new oscillatory modes possible in a compressed array? A favorable geometry for studying such questions is an annulus formed by concentric cylinders which are rotating with angular velocity $\Omega$ and between which radial counterflow is established by heating either the inner or outer boundary.

## 6450 High Energy Physics

**7969 Personal computers in high energy physics.** Quarrie, D.R. (Fermi National Accelerator Lab., Batavia, IL, USA). *Computer Physics Communications;* **45**: No. 1-3, 175-179(Aug 1987). (CONF-870249—).

From Computing high energy physics; Pacific Grove, CA, USA (2 Feb 1987).

The role of personal computers within HEP is expanding as their capabilities increase and their cost decreases. Already they offer greater flexibility than many low-cost graphics terminals for a comparable cost and in addition they can significantly increase the productivity of physicists and programmers. This talk will discuss existing uses for personal computers and explore possible future directions for their integration into the overall computing environment.

## 6451 Particle Interactions And Properties - Experimental

*REFER ALSO TO CITATION(S) 7776, 7790, 8007*

**7970 (ANL-HEP-CP—86-31) Asymmetry in the angular distribution of inclusive Λ baryons from $e^+e^-$ annihilations at $\sqrt{s}$ = 29 GeV.** Abachi, S.; Baringer, P.; Beltrami, I.; Bylsma, B.G.; DeBonte, R.; Koltick, D.; Loeffler, F.J.; Low, E.H.; McIlwain, R.L.; Miller, D.H. (Purdue Univ., Lafayette, IN (USA); Argonne National Lab., IL (USA); Indiana Univ., Bloomington (USA); Michigan Univ., Ann Arbor (USA); Lawrence Berkeley Lab., CA (USA)). May 1986. Contract W-31109-ENG-38. 12p. (CONF-860701—91). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002911/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The forward-backward asymmetry A expected from the $\gamma$ - $Z^0$ interference term in the process $e^+e^- \rightarrow q$ anti q is observed in the lab production angular distribution of high momentum Λ baryons. The data were collected with the High Resolution Spectrometer at PEP and an integrated luminosity of 256 $pb^{-1}$ at $\sqrt{s}$ = 29 GeV was used in the analysis. The asymmetry is seen to increase with the fractional energy $z = 2E/\sqrt{s}$ of the Λ due to the decreasing presence of nonleading particles. The value obtained for Λ baryons with $z \geqq 0.3$ is A = -0.22 +- 0.08 +- 0.02.

**7971 (ANL-HEP-CP—87-62) Hadron production in $e^+e^-$ annihilation at 29 GeV.** Sugano, K. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. (CONF-8704177—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003110/JAW.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

Recent results from HRS on the production of scalar, tensor, and charm mesons and of strange and charm baryons in $e^+e^-$ annihilation are presented. The production of $f_0(975)$, $f_2(1270)$, and $K_2^*(1430)$ is shown briefly. The decays of $D^*(2010)^+$ and $D^*(2007)^0$ are studied in detail. The production of $\Xi^-$ and $\Sigma(1385)^{+-}$ is mentioned. Finally, the preliminary analyses of Λ/sub c/ and Σ/sub c// sup 0,++/ productions are presented.

**7972 (CALT—63-443) Searches for neutrino oscillations.** Vogel, P. (California Inst. of Tech., Pasadena (USA)). 1985. Contract AS03-81ER40002. 14p. (CONF-8504178—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002284/JAW.

From 6. workshop on grand unification; Minneapolis, MN, USA (18 Apr 1985).

The results of searches for neutrino oscillations at nuclear reactors, particle accelerators, and in studies of the energy spectra of weak decays are reviewed. It is concluded that at the present time there is no confirmed evidence for neutrino oscillations, and consequently for neutrino mass and mixing. Limits for the oscillation parameters (mass splitting, mixing angle) are presented. 20 refs., 10 figs.

**7973 (CALT—63-471) Neutrino oscillations at reactors.** Boehm, F. (California Inst. of Tech., Pasadena (USA)). 1986. Contract AS03-81ER40002. 13p. (CONF-8606201—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002289/JAW.

From Neutrino '86; Sendai, Japan (3 Jun 1986).

The results from neutrino oscillation experiments at nuclear reactors are reviewed with focus on the experiment at the Goesgen reactor. 10 refs., 12 figs., 2 tabs.

**7974 (CALT—63-473) Neutrino oscillations at reactors: Review and future possibilities.** Boehm, F. (California Inst. of Tech., Pasadena (USA). Dept. of Physics). 1986. Contract AS03-81ER40002. 9p. (CONF-8606205—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002287/JAW.

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

We review the present status of reactor based neutrino oscillation experiments and sketch the sensitivities that might be achieved in the near future. 10 refs., 7 figs., 2 tabs.

7975 **(CALT—63-476) A search for 17-keV neutrinos in the β-spectrum of $^{63}$Ni.** Wark, D.; Boehm, F. (California Inst. of Tech., Pasadena (USA)). 1986. Contract AS03-81ER40002. 3p. (CONF-8606205—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002359/JAW.

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

In a recent study of the β-decay of $^{3}$H, evidence for the existence of a heavy neutrino of mass ≈17 keV admixed with a strength of ≈3% to the ordinary neutrino have been reported. Despite the failure of several other experiments to find evidence for this neutrino, the topic has remained controversial. This report describes the results of a search for heavy neutrinos in the β-spectrum of $^{63}$Ni using the Caltech double-focusing iron-free β-spectrometer. 7 refs., 2 figs.

7976 **(CERN-EP—87-96) Massive neutrinos logbook.** Vannucci, F. (European Organization for Nuclear Research, Geneva (Switzerland); Paris-7 Univ., 75 (France). Lab. de Physique Nucleaire et Hautes Energies). 27 May 1987. 12p. (CONF-870334—6). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900050/JAW.

From Workshop on results and perspectives in particle physics; La Thuile, Italy (1 Mar 1987).

Experimental results on neutrino masses are given with a list of the limits obtained in direct measurements followed by a discussion of various phenomena arising with massive neutrinos. 11 refs., 2 figs.

7977 **(CONF-8710211—1) A search for neutrino oscillations at LAMPF [Los Alamos Meson Physics Facility].** Freedman, S.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002892/JAW.

From 10. workshop on particles and nuclei; Heidelberg, F.R. Germany (20 Oct 1987).

Experiment E645 is a search for neutrino oscillations, employing the LAMPF beam stop as a neutrino source. Data collection is now underway, and we describe the experiment, the quality of the preliminary data, and the sensitivity to neutrino oscillations that we expect to reach by the end of the 1987 running cycle.

7978 **(DOE/ER/40030—T2) Medium energy measurements of N-N parameters: Progress in research, January 1, 1987-December 31, 1987.** (Texas Univ., Austin (USA)). Oct 1987. Contract AS05-81ER40030. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002793/JAW.

A major part of the work has been and will continue to be associated with research done at the Nucleon Physics Laboratory (NPL) at the Los Alamos Meson Physics Facility (LAMPF). The aim of the experimental program is the determination of the nucleon-nucleon amplitudes at medium energy. The required data include both elastic and inelastic experiments, and in addition the measurement of polarization and polarization transfer parameters. We have been emphasizing single pion production measurements using polarized proton beams, and expect that our present data base will provide stringent tests of theoretical models. With the development of the LAMPF high intensity polarized proton source, we expect that a reasonably intense beam of medium energy polarized neutrons will become available, and are planning a series of experiments utilizing polarized neutrons to determine the importance of the I = 0 reaction amplitudes at medium energies.

7979 **(INIS-mf—10987) Heavy flavour production and heavy flavour mixing at the CERN proton-antiproton collider.** Eijk, B. van. (Amsterdam Univ. (Netherlands)). 15 Apr 1987. 146p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700805/JAW.

In this thesis some results of the proton-antiproton-collision experiment UA1 with the CERN Super Proton-Antiproton Synchrotron are presented and interpreted. Ch. 1 contians a general introduction to the physics motivations behind the proton-antiproton-collider project, a brief description of the CERN facilities and a summary of collider and UA1 physics achievements. Furthermore the concept of studying heavy flavours via their weak decays into muons is introduced. Ch. 2 gives a brief overview of the UA1 experimental set-up, while those parts of the detector that are relevant for the analysis, presented in this thesis, is discussed in some more detail. Ch. 3 contains a short introduction to, and motivation for the use of Monte Carlo techniques in event simulations, while Ch. 4 describes the framework of the recently developed 'EUROJET' event generator. In Ch. 5 a treatment is given of the theoretical background and concepts like 'quark-mixing' and 'CP-violation' are explained, also other useful definitions and formulae are introduced on which the later analysis of the same-sign to opposite-sign dimuon ratio is built. Data collection and event reconstruction is the subject of Ch. 6, while a detailed comparison between the theoretical models and experimentally obtained distributions is given in Ch. 7. Finally, in Ch. 8 some concluding remarks are made. 182 refs.; 81 figs.; 9 tabs. Includes Dutch summary

7980 **(INIS-mf—11064) Production of four-prong final states in photon-photon collisions.** Buijs, A. (Rijksuniversiteit Utrecht (Netherlands)). 2 Mar 1987. 180p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700809/JAW.

Includes summary in Dutch.

This thesis describes the measurement, analysis and discussion of the reaction γγ -> X, where X is a hadronic final state with four charged particles. In particular, we have investigated the states 2π/sup +/2π/sup -/, K/sup +-/π/sup -+/π/sup +/π/sup -/, K/sup +/K/sup -/π/sup +/π/sup -/, 2K/sup +/2K/sup -/ and panti pπ/sup +/π/sup -/. The experiment was performed with the TPC/Two-Gamma facility at the e/sup +/e/sup -/ collider PEP at the Standford Linear Accelerator Center. The process γγ -> 2π/sup +/2π/sup -/ had been measured in the beginning of this decade. The shape of the measured cross section suggested the presence of a resonance in this channel, and many such interpretations were brought forth in the following years. In ch. 2, these interpretations and theories are reviewed and a motivation is given for the investigation of states similar to 2π/sup +/2π/sup -/, but containing kaons and protons. Also, the existing data from related experiments in radiative J/psi decays and hadronic collisions are listed. In the last section of the chapter, the outstanding features of the TPC/Two-Gamma detector for the measurement of four-prong events are emphasized. Ch. 3 is a very brief overview of the kinematical properties of the two-photon initial state, which is brought about by the exchange of two photons by the colliding electron and positron. In ch. 4 the details of the detector system are given, and the method used to measure and analyze events from exclusive four-particle final states is outlined. The results of the measurements are given in ch. 5. Ch. 6 concludes with a discussion of the results, and an interpretation of the measurements. 89 refs.; 68 figs.; 12 tabs.

7981 **(INIS-SU—431, pp 245) Neutrino spectroscopy at the reactor: the results of the first experiments.** Bogatov, S.A.; Ketov, S.N.; Kopejkin, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

7982 **(LBL—22525) Comparison of three-jet and radiative two-jet events in electron-positron annihilation at 29 GeV.** Sheldon, P.D. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003190/JAW.

By comparing 3-jet ($e^+e^- \rightarrow$ q anti q g) and radiative 2-jet ($e^+e^- \rightarrow$ q anti q γ) events from electron-positron annihilation, we have studied the local and global effects of the presence of a hard bremsstrahlung gluon in hadronic events. Detector and event selection efficiencies and biases affect these two kinds of events almost equally because they have very similar kinematics and topologies. Accurate comparisons of q anti q g and q anti q γ events can therefore be made. Globally, we observe a depletion of hadrons in q anti q g events relative to q anti q γ events on the opposite side of the

event plane from the gluon, in the angular region between the q and anti q jets. This depletion is shown to be in agreement with the predictions of Quantum Chromodynamics (QCD). The existence of this effect demonstrates that the presence of a gluon significantly alters the color forces and hence the fragmentation process in hadronic events. We also use these q anti q γ and q anti q g events to compare low energy (4.5 GeV) gluon and quark jets. Our data indicate that gluon jets have softer x/sub p/ distributions than quark jets, while the transverse momentum distributions of these two types of jets are identical within our errors. Although we are unable to determine if the multiplicities of gluon (n/sub /) and quark (n/sub q/) jets are different, the ratio n/sub g//ıı/sub q/ = 9/4 predicted asymptotically in QCD would not be consistent with our data.

7983 **(LBL—23922) The physics of jets.** Hofmann, W. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 40p. (CONF-870797—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002740/JAW.

From International symposium on lepton and photon interactions at high energies; Hamburg, F.R. Germany (27 Jul 1987).

Recent data on the fragmentation of quarks and gluons is discussed in the context of phenomenological models of parton fragmentation. Emphasis is placed on the experimental evidence for parton showers as compared to a fixed order QCD treatment, on new data on inclusive hadron production and on detailed studies of baryon production in jets.

7984 **(LYCEN-TH—8627) Production of the charmonium chi/sub 1/ and chi/sub 2/ in pantip annihilation at the ISR.** Fay, J. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Mar 1986. 166p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751426/JAW.

R704 experiment has studied the chi/sub 1/ and chi/sub 2/ charmonium states (cantic) in their J/Psi gamma decay. These states are directly formed in the interaction of a hydrogen molecular jet target with an antiprotons beam permanently cooled, circulating in the ring 2 of the ISR. This process allows a high luminosity to be reached (up to 3 10/sup 30/ cm/sup -2/ s/sup -1/). The huge hadronic background leads to detect only electromagnetic final states. The detector is a two-arm no magnetic spectrometer in two parts. The first one is devoted to charged particle detection: tracking (MWPC, scintillators) and electron identification (Cerenkov). The second one forms a calorimeter measuring the position and the energy of photons and electrons (lead-scintillator sandwiches, proportional chambers using analogue read-out and lead-glass wall). Event selection is based on Psi identification from two electron tracks (one in each arm) and search for the radiated photon reconstructed from the Chi decay kinematics. For Chi/sub 1/ and Chi/sub 2/ respectively, a set of 32 and 55 events is found with a negligible background level and one obtains values on mass, width and branching ratios on p anti-p. These results are compared with theoretical prediction from QCD inspired models: masses are well described by potential methods and sum rules (within a 10 MeV uncertainly). For the widths, only a raw value can be achieved while branching ratios are in good agreement with our measurements.

7985 **(PCCF-T—86-06) Experimental study of CR and CP invariances in short-distance proton-antiproton collisions, at the CERN storage rings (I.S.R.).** Ziane, A. (Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire). Sep 1986. 172p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751427/JAW.

The R608 experiment was performed at C.E.R.N.-I.S.R. Here, we compared inclusive reactions for the production at 90 degrees of a single pion (or kaon) at SQRT (s) equal to 52.7 GeV, in proton-proton and proton-antiproton collisions. The acceptances are given from Monte-Carlo calculations. We check carefully the working and the stability of the experimental apparatus. The particles are identified by using silica aerogel counters. We give two kinds of physical results: The comparison of inclusive invariant cross sections for production of pions plus and minus in the transverse momentum range 0.63 to 2.23 GeV/c. No significant difference appears in proton-proton and proton-antiproton reactions. We give a single fit for the four processes corresponding to the intermediate zone between those one described by thermodynamic models and parton models; the test of CR and CP invariances for proton-antiproton collisions in the production of a single pion or kaon at 90 degrees in the centre of mass system, for the transverse momentum range 0.35 to 2.23 GeV/c. Statistical tests from pions minus and plus give the maximum limit for the relative violation amplitudes. The measurement of the asymmetry parameters leads to the determination of these relative amplitudes. The final weighted mean is the more precise up to date with an order of magnitude higher for the available total energy. It is not necessary to call short distance phenomena and the upper limit for the violation is lower than 3/1000.

7986 **(SLAC—315) Proceedings of the third Mark II workshop on SLC physics.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jul 1987. Contract AC03-76SF00515. 315p. (CONF-870298—). NTIS, PC A14. Order Number DE88002997/JAW.

From 3. MARK II workshop on SLC physics; Watsonville, CA, USA (25 Feb 1987).

Separate abstracts were prepared for 27 papers in these workshop proceedings. (LEW)

7987 **The superconducting super collider: Scientific motivation and technical progress.** Quigg, C. (Fermi National Accelerator Lab., Batavia, IL). pp 736-762 of Proceedings of the 6th topical workshop on proton-antiproton collider physics. Eggert, K.; Faissner, H.; Radermacher, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-8606286—).

From 6. international conference on proton-antiproton physics; Aachen, F.R. Germany (30 Jun 1986).

The author summarizes the case for new physics at the TeV scale, and reviews speculations about new phenomena which may occur there. He then discusses in brief the physics prospects of a multi-TeV hadron collider, and mention some of the processes which may be studied in detail with such an instrument. Finally, he reports progress toward the design and construction of the SSC.

7988 **The observation and phenomenology of glueballs.** Lindenbaum, S.J. (Brookhaven National Lab., Dept. of Physics, Bldg. 510A, Upton, NY 11973). pp 548-589 of Superstrings, supergravity and unified theories. Furlan, G.; Jengo, R.; Pati, J.C.; Sciama, D.W.; Shafi, Q. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8506324—).

From Summer workshop on high energy physics and cosmology; Trieste, Italy (10 Jun 1985).

One can prove the g/sub T/, g/sub T'/, and g/sub T"/ are glueballs with the appropriate input axioms. Then as the author concluded the g/sub T/(2050), g/sub T'/(2300) and g/sub T"/(2350) are produced by 1-3 primary J/sup PC/ = 2/sup ++/ glueballs, if one assumes as input axioms: 1. QCD is correct; and 2. The OZI rule is universal for weakly coupled glue in disconnected Zweig diagrams where the disconnection is due to the creation or annihilation of new flavor(s) of quark(s), and J ≧ 1 for the disconnected system (to avoid possible vacuum mixing effects). The authors has previously stated that the BNL/CCNY g/sub T/(2050), g/sub T'/(2300) and g/sub T"/(2350) are naturally explained within the context of QCD by concluding they are produced by 1-3 primary glueballs. One or two broad primary glueballs could in principle break down the OZI suppression and mix with one or two quark states which accidentally have the same quantum numbers and nearly the same mass. However the simplest explanation of the rather unusual characteristics of his data is that he has found a triplet of J/sup PC/ = 2/sup ++/ glueball states.

7989 **Detecting the Higgs in purely leptonic decay modes.** Gunion, J.F.; Soldate, M. (Dept. of Physics, Univ. of California, Davis, CA 95616). pp 79-92 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The authors outline the procedures required in order to detect a high mass, standard model Higgs boson in purely leptonic decay modes. They consider a variety of masses, m/sub H/, above the two-Z threshold, m/sub H/>2 m/sub Z/, at center of mass energy, $\sqrt{s}$ = 40 TeV. Rough estimates of cross sections, event rates, and errors as a function of luminosity are given. They emphasize the importance of simultaneous measurement of the WZ continuum in order to normalize the background. A high luminosity interaction region would be enormously helpful.

## 6452 Particle Interactions And Properties - Theoretical

*REFER ALSO TO CITATION(S) 7983, 7988, 8011, 8065*

**7990 (ANL-HEP-CP—87-53) Heavy quark production in hadron collisions.** Berger, E.L. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 51p. (CONF-870339—5). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003106/JAW.

From Moriond meeting on hadrons, quarks and gluons; Les Arcs, France (15 Mar 1987).

Theoretical developments in the dynamics of heavy quark production in hadronic collisions as well as recent data are discussed. Focus is principally on bottom quark production. Extensive calculations of cross sections and production spectra for both collider and fixed target energies are presented. Available data are in excellent agreement with expectations of lowest order perturbative quantum chromodynamics. Uncertainties in the theoretical estimates are explored. The paper includes calculations and comments on charm and top quark production.

**7991 (BNL—40359) The approach to equilibrium in a quark-gluon plasma.** Heinz, U. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 13p. (CONF-8708166—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002117/JAW.

From 6. international conference on ultrarelativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

The basic questions to be addressed in this paper are: How does the quark-gluon plasma, once formed in heavy-ion collisions, approach equilibrium? What are the basic equilibrium time scales - how do they compare with the plasma lifetime before hadronization and freeze-out set in? In particular, how do the strong color anisotropies, which are presumably present in the initial formation stage disappear and how fast, if at all, do the color degrees of freedom attain local equilibrium? The approach that I wish to present here involves the following chain of arguments: equilibration is related to dissipation of energy and creation of entropy; it is determined by the dissipative, i.e., imaginary part of certain response functions - for example, to calculate the rate of dissipation for a density perturbation in an equilibrium plasma we need to work out the imaginary part of the retarded density-density correlation function; this imaginary part of the response function is dominated by its poles which signal collective modes - for example, phonons in the density-density correlation function, (colored) plasmons in the electric and magnetic response functions, etc.; from the imaginary part one can calculate a damping rate $\gamma$ for these collective modes which in turn yields an estimate for the equilibration time scale tau/sub equ/ ~ h-bar/$\gamma$. In this contribution I will concentrate on color equilibration and thus focus on color electric and magnetic plasma oscillations and their damping rates. 21 refs.

**7992 (INIS-SU—431, pp 220) Limits of changing of weak interaction constant from helium-4 abundance.** Kramarovskij, Ya.M.; Chechev, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

**7993 (INIS-SU—431, pp 229) Neutrino and reactor antineutrino elastic scattering on electrons and neutrino electromagnetic moments.** Kerimov, B.K.; Safin, M.Ya.; Khajdar, N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

**7994 (INIS-SU—431, pp 231) Energy dependence of asymmetry parameters of free polarized neutron $\beta$ decay with account of antineutrino.** Kerimov, B.K.; Samsonenko, N.V.; Chkhotu Lal Katkhat. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

**7995 (INIS-SU—431, pp 247) Neutron spectra in antineutrino-deuteron weak interaction.** Bychuk, O.V.; Vladimirov, D.M.; Gaponov, Yu.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

**7996 (INS-J—171) High energy nuclear collective effects in photo-nuclear reactions.** Koike, Masahiro. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). Jul 1987. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751430/JAW.

High energy nuclear collective effects in ($\gamma$,p) reactions on medium weight nuclei have been studied. Incident photon energies, which are determined with a photon tagging system, are from 327 to 527 MeV with a 40 MeV step. Inclusive proton momentum spectra covered from 300 to 900 MeV/c at backward angles, 90 deg to 150 deg, are analyzed in terms of a local equilibrium model. The size and effective mass of a localized hot nuclear matter (fireball) created in the target nucleus are estimated from their recoil velocity, which is determined to fit the proton spectrum based on an evaporation model. Also estimated are the thermodynamical properties, such as the temperature, energy density, lifetime, relaxation time etc. The temperature of the excited nuclear matter extracted from the proton spectrum is much lower, about 30 % typically, than that expected from the deposited energy by the reaction. It suggests that the temperature of the created matter is reduced by the sudden change of the density. Accordingly, the nuclear thermal compressibility is estimated to be about 230 MeV from the information of the temperature, pressure and density. On the space-time consideration, however, many difficulities appear in the fireball formation, which may be universal in all of the hadron statistical model. A new collective model in high energy nuclear structure is proposed within the framework of quantum chromodynamics (QCD) to describe the fireball formation mechanism and their decay process, based on a bag picture including their space-time properties.

**7997 (LAL—87-28) Meson D photoproduction in NA14 experiment: a RCD test.** Krafft, C. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jun 1987. 171p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751415/JAW.

In this thesis we present some features of the production mechanisms and lifetime measurements for charm D mesons using the data collected by the NA14 photoproduction experiment at CERN. A method to select the charm events has been studied which reduces the set of events to analyse completely. It has been developed using a silicon Microvertex detector which enables us to reconstruct accurately the tracks positions. This detector was also used for the determination of the production and decay vertices. Inclusive D signals have been obtained after rejection of an important combinatorial background, through cuts over the distance of flight divided by its error. P/sup 2//sub T/ and energy distributions, showing a good agreement between the data and the QCD model

of photon-gluon fusion with a Lund hadronization, have been obtained.

7998 **(LAL—87-30) Supersymmetric particle research with UA2 detector at the CERN pantip accelerator.** Ansari Foumani, R. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jun 1987. 154p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751416/JAW.

Supersymmetric theories predict the existence of new particles, partners of ordinary matter: scalar particles associated to fermions, and new spin 1/2 particles, partners of spin 0 or 1 ordinary bosons. The masses of these particles are unknown parameters of the theory. We have searched for a possible sign of existence of these new particles using the data taken by the UA2 detector at the CERN pantip collider. We have tested scalar electron and wino masses through the study of the decay of the Z boson into these particles. Scalar electrons with masses below into these particles. Scalar electrons with masses below 29 GeV/c/sup 2/ (for a massless photino), and winos below 45 GeV/c/sup 2/ (for massless scalar neutrinos) are not compatible with our data. We exclude also scalar quark masses in the range of 9 to 46 GeV/c/sup 2/, and gluino masses above 15 GeV/c/sup 2/, and below 50 GeV/c/sup 2/ in the case of an unstable photino. The limits are however less restrictive if the photino is stable. A new vector boson Z' below 180 GeV/c/sup 2/ or W' below 209 GeV/c/sup 2/ are incompatible with our data.

7999 **(OUP—87-28) On the structure of the eta$\pi$w vertex in the standard model.** Eeg, J.O.; Lie-Svendsen, Oe. (Oslo Univ. (Norway). Fysisk Inst.). Sep 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751310/JAW.

Inspired by the recent claim of a ~5% branching ratio for tau->eta$\pi\nu$, we consider the form factors f/sub +/- for the weak transition eta->$\pi$ by means of the MIT bag model, chiral lagrangians, and a chiral quark loop model. We find contributions to f/sub +/ and f/sub -/ comparable in size and of order 10/sup -3/, which is roughly one order of magnitude below the contribution for f/sub +/ from $\pi$/sup o/-eta mixing, found in a recent paper. However, the nonzero values for f/sub -/ turn to be more important for the total rate: Including contributions to f/sub -/, we find a branching ratio ~10/sup -4/, one order of magnitude larger than that due to $\pi$/sup o/-eta mixing alone.

8000 **(PITHA—87/14) Forward-backward asymmetry in two-jet events: Signature of axigluons in proton-antiproton collisions.** Schgal, L.M.; Wanninger, M. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). Aug 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751301/JAW.

Models of chiral colour suggest the existence of massive axigluons with strong couplings to quarks. Interference of gluon- and axigluon-induced amplitudes will give rise to a forward-backward asymmetry in qanti q -> Qanti Q which will be reflected in two-jet events containing a prompt lepton. We estimate this asymmetry for the CERN and Fermilab colliders.

8001 **(RRK—87-15) Unified approach to D -> $\pi$K-bar, KK-bar and $\pi\pi$ and K -> $\pi\pi$ decays and a solution to the puzzle of $\Gamma$(D/sup 0/ -> K/sup +/K/sup -/)/$\Gamma$(D/sup 0/ -> $\pi$/sup +/$\pi$/sup -/).** Terasaki, K.; Oneda, S. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Jul 1987. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751459/JAW.

A non-perturbative algebraic approach, which deals with long distance physics in earnest but also maintains a close contact with quark-line diagrams, has been applied to the derivation of the chemical bond$\Delta$I vectorchemical bond = 1/2 rule in the K -> 2$\pi$ decays. Reasonable estimates of the rates of D/sup 0/ -> $\pi$anti K and phianti K/sup 0/ decays in terms of the rate of K/sub S//sup 0/ -> $\pi\pi$ decay have also been obtained, to the approximation in which excited state contributions to the on-mass-shell intermediate states which appear in the amplitudes are neglected. In this paper, we promote our unified approach to the D -> $\pi$anti K, K anti K and $\pi\pi$ and K -> $\pi\pi$ decays further, by including the four-quark [QQ][anti Qanti Q] meson contribution to the on-mass-shell intermediate states. We find that it provides us with not only a solution to the well-known puzzle of the observed branching ratios of the Cabibbo suppressed decays of D/sup 0/-meson, $\Gamma$(D/sup 0/ -> K/sup +/K/sup -/)/$\Gamma$(D/sup 0/ -> $\pi$/sup +/$\pi$/sup -/) ≃ 4, but also a significantly improved prediction on $\Gamma$(D/sup 0/ -> $\pi$anti K) in comparison with $\Gamma$(K/sub S//sup 0/ -> $\pi\pi$).

8002 **(UEF—04-86) Analysis of reaction $\pi$/sup +/A->etaX and formation length of eta-mesons.** Vinogradov, V.B.; Kul'chitskij, Yu.A.; Martinska, G.; Ferencei, J. (Joint Inst. for Nuclear Research, Dubna, USSR; AN Belorusskoj SSR, Minsk. Inst. Fiziki; Univerzita P.J. Safarika, Kosice, Czechoslovakia; Slovenska Akademia Vied, Kosice, Czechoslovakia. Ustav Experimentalnej Fyziky). (Slovenska Akademia Vied, Kosice (Czechoslovakia). Ustav Experimentalnej Fyziky). Sep 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700828/JAW.

Within the Bialas hadron-nucleus model (FZ model), an analysis is performed of experimental data of inclusive formation of eta-mesons in the reaction $\pi$/sup +/A->etaX at an energy of 10.5 GeV in the Feynman variable range of 0.6 ≦x≦1. Using the model, the values were determined from experimental data, of the formation length of eta-mesons with a momentum of 6 to 10 GeV/c; the lengths range between 0 and 3 fm. Also determined was the value of parameter $\mu$/sup 2/=1.2+-0.3 GeV/sup 2/. It is shown that selecting the cross section of the intermediate state interaction $\sigma$/sup */=0 and the value of parameter $\mu$/sup 2/=1.2 GeV/sup 2/, the model reproduces the experimental data. (Z.J.) 3 figs., 22 refs.

8003 **A non-numerical method for track finding in experimental high energy physics using vector computers.** Georgiopoulos, C.H. (Supercomputer Computations Research Institute, Florida State Univ., Tallahassee, FL 32306-4052). pp 304-314 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The author has described here a non-numerical track finding technique implementing the use of a vector computer that effectively gains a factor of ten in speed compared to scalar mode algorithms. He expects this technique to be even more valuable for higher multiplicity experiments, such as exist at various collider detectors. Other algorithms which appear to lend themselves to vectorization are also under consideration at the moment. For example, an approach developed by the MARK III group at SLAC [2] appears very promising. In any case, development of vector algorithms is under way for the more complicated problems of track finding in collider experiments with charged tracks inside a magnetic volume.

8004 **Signatures and triggering for new physics at the SSC.** Kane, G. (Randall Physics Lab., Univ. of Michigan, Ann Arbor, MI 48109). pp 23-41 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

In this paper some of the signatures for new physics at future colliders are described, with emphasis on features that can help in constructing fast triggers to extract the physics from large backgrounds. The most emphasis is given to W pairs, with some discussion of the motivation, since the associated physics is the only kind where calculable Standard Model predictions exist. Several kinds of hypothetical new physics such as supersymmetry, technicolor, rare decays, etc. are briefly discussed.

8005 **Topological theory of strong and electroweak interactions.** Finkelstein, J. pp 184-188 of A passion for physics: Essays in honor of Geoffrey Chew. De Tar, C.; Finkelstein, J.; Tan, C.I. Philadelphia, PA; Taylor and Francis Inc. (1985).

Some time ago it was argued by Veneziano that a good first approximation to hadronic scattering amplitudes would consist of those contributions whose Harari-Rosner duality diagrams were planar; these were said to constitute the "planar amplitudes". The idea of the topological expansion was that all of the corrections to this planar approximation (namely those contributions whose duality diagrams require surfaces of greater topological complexity) could at least in principle be obtained from iterations of the planar amplitudes. Originally, the existence of baryons and of particle spin could not be treated seriously by this expansion; the program to be discussed in this paper is an extension of the topological expansion to include the effects of spin and of the existence of baryons. By virtue of this extension, what began as, at best, a toy model of the strong interactions, has become a candidate for a theory of all particle interactions. The comments made in this paper concern two developments that have arisen from the topological program: these are, first, that predictions could be made for quantities such as the number of hadron generations, and second, that the theory could be extended so as to encompass the electroweak interactions.

## 6453 Particle Invariance Principles And Symmetries

*REFER ALSO TO CITATION(S) 7950*

8006 **(BNL—40398) Tests of conservation laws.** Goldhaber, M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-8706176—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002630/JAW.

From Workshop and symposium on the physics of low energy, stored, and trapped particles; Stockholm, Sweden (14 Jun 1987).

For quite a while it has been realized that some discrete quantum numbers are conserved in some interactions but not in others. The most conspicuous cases are parity PP, charge conjugation C, and the product CP which are conserved in strong and electromagnetic interactions but not in weak interactions. The question arises whether for some of the other conserved quantities, which are conserved in strong, electromagnetic and weak interactions, there is an interaction intermediate in strength between weak and gravitational which violates these quantum numbers, e.g., baryon number B and lepton number L. The possibility exists that these conservation laws, if they are broken at all, are only broken by the gravitational force which would make the mass of an intermediate boson which induces the breakdown equal to the Planck mass. 6 refs., 1 tab.

8007 **(DOE/ER/02197—104) Hadronic atoms and leptonic conservations: technical progress report, February 1, 1987-January 31, 1988.** Kunselman, R. (Wyoming Univ., Laramie (USA)). 1987. Contract AC02-76ER02197. 13p. (COO—2197-104). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001626/JAW.

The 1986 efforts on leptonic conservations have been on experiments at TRIUMF and LAMPF involving searches for a lepton flavor-violating reaction. The efforts on hadronic atoms (atoms formed with pions, kaons, and sigma-minus particles) have been on the completion of analyses from the experiments at TRIUMF, LAMPF, and BNL. The experiment on leptonic conservations at TRIUMF is MUBAR, an attempt to measure the rate of the muonium to antimuonium conversion process ($\mu^+e^- \rightarrow \mu^-e^+$). The reaction would violate additive lepton flavor conservation. Details of this experiment are contained in this paper. Concerning hadronic atoms at LAMPF, the analysis on pionic atoms from Fe, Co, and Ni isotopes has been completed. The energies and the widths of the 3d-2p x-ray transitions which were the last observed transitions before the pion was captured by the nucleus have been measured.

## 6454 Field Theory

8008 **(DOE/ER/40325—02) Four-dimensional strings.** Dolan, L. (Rockefeller Univ., New York (USA)). Aug 1987. Contract AC02-87ER40325. 13p. (RU—B1/14; CONF-8707129—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002341/JAW.

From Workshop on superstring; Boulder, CO, USA (27 Jul 1987).

The partition function and algebraic structure of the four-dimensional strings derived from compactification of the type II superstring are discussed.

8009 **(INP—1271/PH) Abelian gauge theories with tensor gauge fields.** Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700826/JAW.

Published in 1985.

Gauge fields of arbitrary tensor type are introduced. In curved space-time the gravitational field serves as a bridge joining different gauge fields. The theory of second order tensor gauge field is developed on the basis of close analogy to Maxwell electrodynamics. The notion of tensor current is introduced and an experimental test of its detection is proposed. The main result consists in a coupled set of field equations representing a generalization of Maxwell theory in which the Einstein equivalence principle is not satisfied.

8010 **(SLAC-PUB—4440) Two loop partition function in (compactified) heterotic string vacua.** Atick, J.J.; Sen, A. (Institute for Advanced Study, Princeton, NJ (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC02-76ER02220;AC03-76SF00515. 9p. (CONF-8707129—2; IASSNS-HEP—87/53). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002562/JAW.

From Workshop on superstring; Boulder, CO, USA (27 Jul 1987).

Two loop partition function for the heterotic string theory, compactified on any background preserving space-time supersymmetry at the string tree level, is explicitly calculated. This includes $E_8 \times E_8$ or SO(32) heterotic string theory in ten dimensional flat space-time.

8011 **From the bootstrap to superstrings.** Schwarz, J.H. pp 106-113 of A passion for physics: Essays in honor of Geoffrey Chew. De Tar, C.; Finkelstein, J.; Tan, C.I. Philadelphia, PA; Taylor and Francis Inc. (1985).

Among the important ideas developed in the 1960's were the hadronic bootstrap and the Regge-pole description of hadronic amplitudes. Chew emphasized the importance of concentrating on physically observable S-matrix elements and dispensing with extraneous baggage (i.e., quantum fields for hadrons). Analyticity in angular-momentum variables was stressed as an important ingredient for understanding the hadronic S-matrix, Regge poles being the principle observable consequence. Later, the study of Regge poles and the bootstrap led to the discovery of duality and "finite-energy sum rules". These ideas culminated in Veneziano's 1968 discovery of a specific mathematical function that embodies these ideas. Superstring theory in its modern form looks so different from this, that is difficult to believe that these were the origins that led to its development. Shortly after Veneziano's discovery of a "dual" four-particle amplitude, N-particle generalizations that factorize consistently on a well-defined spectrum of states were found. It was shown that the states could be regarded as modes of a relativistic one-dimensional system (string), and the interactions interpreted in terms of breakings and joinings of the string. This string theory turned out to have some serious problems, however. It has tachyons in both the open-string and closed-string sectors, it contains no fermions, it has divergent loop amplitudes, and it requires that space-time have 26 dimensions.

# 65 PHYSICS II

## 6510 Nuclear Physics

8012 **(CONF-871186—3) Some notes on the calculation of energy-angle correlated distributions with TNG and their representation in File 6 formats.** Larson, D.C.; Fu, C.Y.; Hetrick, D.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002624/JAW.

From Meeting on the international nuclear data library for fusion reactor technology; Vienna, Austria (16 Nov 1987).

The model code TNG has been extensively used in evaluation work of structural materials for ENDF/B-VI performed at Oak Ridge National Laboratory. A new aspect of ENDF/B-VI is the use of File 6 formats for energy-angle correlated data. Such data are generally calculated, anchored by experimental data. In this informal note we outline how the TNG results are calculated and entered in the File 6 formats. 4 refs.

8013 **(ECN—200) Systematics of neutron-induced isomeric cross-section ratios at 14.5 MeV.** Kopecky, J.; Gruppelaar, H. (Netherlands Energy Research Foundation, Petten). Aug 1987. 37p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700787/JAW.

The present status of the knowledge on branching ratios of the isomeric and ground-state cross sections at 14 to 15 MeV is reviewed. Earlier systematics for the isomer ratios of the (n,n'), (n,p), (n,t), (n,$\alpha$) and (n,2n) reactions are examined and new systematics for these reactions are presented. A comparison with model calculations is discussed. The (n,2n) isomer ratios show a behaviour different from that of the studied one-step reactions. An extensive table with experimental information on (n,2n) cross section data at 14 to 15 MeV has been included. 5 figs.; 15 refs.; 1 table.

8014 (INIS-SU—431, pp 53) **Resonance excitation of nuclear levels by means of $\gamma$-quanta from the (n,$\gamma$) reaction.** Begzhanov, R.B.; Gladyshev, D.A.; Kobilov, O.Sh.; Kulabdullaev, G.A.; Gaffarov, D. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8015 **(IPNO-TH—87-8) Electromagnetic form factors.** Desplanques, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 6p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751398/JAW.

Electromagnetic form factors, in first approximation, are sensitive to spatial distribution of nucleons and to their current. In second approximation, more precise effects are concerned, whose role is increasing with momentum transfer and participating essentially of short range nuclei description. They concern of course the nucleon-nucleon interaction while approaching each other and keeping their free-state identity, but also mutually polarizing one the other. In this last effect, radial and orbital excitations of nucleon, the nucleon mesonic cloud modification and the nucleon antinucleon pair excitation are included. In this paper, these contributions are discussed while trying to find the important elements for a good description of form factors. Current questions are also discussed. Light nuclei are essentially concerned.

8016 **(UCID—21036) The present status of the LLNL Evaluated Charged Particle Library (ECPL).** Mac Gregor, M.H. (Lawrence Livermore National Lab., CA (USA)). 13 Mar 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002994/JAW.

The present report is written with two purposes in mind: to summarize the charged-particle reactions that presently exist in Evaluated Charge Particle Library; and to list all of the low-Z charged-particle reactions for which data exist in the Livermore experimental data compilation. 2 tabs.

## 6511 Experimental Techniques

8017 **(INIS-SU—431) Nuclear spectroscopy in neutron reactions. Summaries of reports of 37. All-Union conference on nuclear spectroscopy and nuclear structure, Yurmala, 14-17 Apr 1987.** (AN SSSR, Moscow; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; AN Latvijskoj SSR, Riga; AN Latvijskoj SSR, Riga. Inst. Fiziki). 1987. 611p. (In Russian). (CONF-8704221—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW.

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

Individual papers in these conference proceedings are separately indexed. (LEW)

## 6512 Nuclear Properties And Reactions, A=1-5, Experimental

8018 **(CONF-870413—16) Superratio for inelastic pion scattering from /sup 3/H and /sup 3/He.** Berman, B.L.; Briscoe, W.J.; Kramer, L.H.; Mokhtari, A.; Petrov, A.M.; Sadler, M.E.; Barlow, D.B.; Nefkens, B.M.K.; Pillai, C. (George Washington Univ., Washington, DC (USA). Dept. of Physics; Abilene Christian Univ., TX (USA). Dept. of Physics; California Univ., Los Angeles (USA). Dept. of Physics). 1987. Contract FG05-86ER40285;AS03-81ER40021;AS05-81ER40036. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001470/JAW.

From 11. international conference on particles and nuclei; Kyoto, Japan (20 Apr 1987).

This paper reports the measurement of superratio for inelastic pion scattering. The measured spectrum for pion-plus helium-3 scattering is given. (LSP)

## 6513 Nuclear Properties And Reactions, A=6-19, Experimental

8019 (INIS-SU—431, pp 263) **On effect of neutrino mass on asymmetry value in $\mu$/sup -/-meson capture by /sup 12/C nucleus.** Brilev, E.V.; Chkhotu Lal Katkhat. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8020 **(IPNO-TH—87-39) On the nuclear response to the added strangeness: recent developments in hypernuclear physics.** Bouyssy, A.; Zofka, J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). 1987. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751403/JAW.

Present situation in understanding and producing the hypernuclei is briefly reviewed here. In particular, $\Sigma$-hypernuclear characteristics and their model descriptions are discussed. Also the quasifree process inclusions are described. In the second part, pertinent properties of new production reactions ($\pi$,K/sup +/), ($\gamma$,K/sup +/), (e,e'K/sup +/), (p,K/sup +/), (K/sup -/,$\pi$X), (K/sup -/,$\pi\gamma$) are related to open problems of $\Lambda$/sup -/ and $\Sigma$-hypernuclei.

8021 **Is the 9.13 MeV level of $^{14}$N a doublet.** Warburton, E.K. (Brookhaven National Lab., Upton, NY, USA). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 6, 523-527(Jun 1986). Contract AC02-76CH00016.

A set of best excitation energies is presented for $^{14}$N. These are used as the basis of a discussion of the evidence for a doublet at 9.13 MeV in $^{14}$N. It is concluded that the evidence for such a doublet comes only from $^{12}$C($^{3}$He,p) $^{14}$N(p')$^{13}$C GS angular correlations and cannot be taken very seriously without further collaborating evidence.

## 6515 Nuclear Properties And Reactions, A=39-58, Experimental

8022 (INIS-SU—431, pp 55) **On excitation of /sup 44mg/Sc isomeric nuclei.** Baskova, K.A.; Makuni, B.M.; Chugaj, T.V.; Shavtvalov, L.Ya. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8023 (INIS-SU—431, pp 57) **Lifetime of /sup 48/Ti and /sup 52/Cr excited states.** Georgiev, A.K.; Georgieva, M.; Elenkov, D.V.; Lefterov, D.P.; Tumbev, G.Kh. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

## 6516 Nuclear Properties And Reactions, A=59-89, Experimental

8024 (INIS-SU—431, pp 58) **Multipole mixture of γ-transitions in /sup 62,64/Ni.** Kosyak, Yu.G.; Kaipov, D.K.; Chekushina, L.V.; Lysikov, Yu.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8025 (INIS-SU—431, pp 59) **Lifetime of /sup 65/Cu excited states from the (n,n'γ) reaction.** Dostemesova, G.A.; Kaipov, D.K.; Kosyak, Yu.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8026 (INIS-SU—431, pp 60) **Population of /sup 65/Cu levels, corresponding to phonon+particle excitation in inelastic scattering of reactor fast neutrons.** Arynov, S. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8027 (INIS-SU—431, pp 61) **Structure of /sup 69/Ga excited states.** Kosyak, Yu.G.; Kaipov, D.K.; Chekushina, L.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8028 (INIS-SU—431, pp 63) **Lifetime of /sup 78,80/Se excited states.** Kaipov, D.K.; Kosyak, Yu.G.; Dostemesova, G.A.; Lysikov, Yu.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8029 (INIS-SU—431, pp 65) **Decay scheme of /sup 85/Sr energy levels, populated in the /sup 76/Ge(/sup 13/C,3nγ) reaction.** Zobov, A.E.; Izotov, A.L.; Lemberg, I.Kh.; Mishin, A.S.; Rassadin, L.A.; Chugunov, I.N. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8030 (INIS-SU—431, pp 66-67) **/sup 86/Y decay.** Belyavenko, V.S.; Vishnevskij, I.N.; Zheltonozhskij, V.A.; Reshit'ko, S.V.; Ukhin, M.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8031 (INIS-SU—431, pp 71) **Investigation of prompt gamma decay of neutron-rich nuclei.** Bogdzel', A.A.; Gundorin, N.A.; Duka-Zojmi, A.; Kliman, Ya. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8032 (INIS-SU—431, pp 96) **Isotopic changes of mean square charge radii of samarium and neodymium isotopes at N<82.** Alkhazov, G.D.; Barzakh, A.E.; Buyanov, N.B. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8033 (INIS-SU—431, pp 179) **Study on the isotopic changes in charge density distribution in selenium nuclei.** Kuprikov, V.I.; Soznik, A.P.; Khomich, A.A.; Shevchenko, N.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8034 (INIS-SU—431, pp 238) **Refinement of Δλ/λ/sup 75/Se.** Makaryunas, K.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8035 (INIS-SU—431, pp 239) **Changes of the /sup 64/Cu decay rate in the chemical compositions.** Makaryunas, K.V.; Makaryunene, Eh.K.; Dragunas, A.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8036 (INIS-SU—431, pp 240) **Changes of the /sup 71/Ge decay rate in the chemical compositions.** Makaryunas, K.V.; Dragunas, A.K.; Makaryunene, Eh.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8037 (INIS-SU—431, pp 241) **Change of probability ratio of electron capture to positron decay of /sup 68/Ga in chemical compounds.** Remejkis, V.V.; Dragunas, A.K.; Makaryunas, K.V.; Ruzhyale, B.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8038 **Yrast decays in sup(87,89)Zr, sup(87,88,89,90)Y and $^{86}$Sr from sup(74,76)Ge($^{16}$O,xn,yp,zαγ) reactions.** Warburton, E.K.; Olness, J.W.; Lister, C.J.; Becker, J.A.; Bloom, S.D. (Brookhaven National Lab., Upton, NY, USA; Lawrence Livermore National Lab., CA, USA). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 10, 1017-1045(Oct 1986).

Gamma-ray data from sup(74,76)Ge + $^{18}$O fusion-evaporation reactions are analysed to provide data on yrast decay schemes in sup(87,89)Zr, sup(87,88,89,90)Y and $^{86}$Sr. The data include excitation functions, angular distributions, γ-γ coincidences, linear polarisation measurements and lifetimes deduced from both Doppler shift attenuation and recoil distance measurements. Shell-model calculations are presented for sup(88,90)Y and $^{86}$Sr.

## 6517 Nuclear Properties And Reactions, A=90-149, Experimental

8039 (AERE-R—12612) **/sup 93/Nb (n, n')sup(93m)Nb cross-section.** Gayther, D.B.; Uttley, C.A.; Murphy, M.F.; Taylor, W.H.; Randle, K. (UKAEA Harwell Lab. Nuclear Physics Div.; UKAEA Atomic Energy Establishment, Winfrith; Birmingham Univ., UK. Dept. of Chemistry). (UKAEA Harwell Lab. Nuclear Physics Div.). May 1987. 32p. H.M. Stationery Office, London, price Pound 5.00.

Measurements of the 30 keV isomer production cross-section in /sup 93/Nb excited by neutron inelastic scattering have been made at ten neutron energies in the range 1 to 6 MeV. Small foils of niobium were exposed to high fluences of "monoenergetic" neutrons and the cross-section was determined from the K x-ray activities so induced. The detector used in the activation measurements was calibrated with a standard solution of sup(93m)Nb which is used as an international reference material for reactor neutron dosimetry. The neutron fluence of the irradiation was measured with a low efficiency /sup 235/U fission chamber in which the fissile deposit is located immediately behind the niobium foil. The sup(93m)Nb production cross-section is thus determined relative to the /sup 235/U(n,f) standard reference cross-section. Comparisons are made with nuclear model calculations of the cross-section and recommended values based on these and the experimental data are presented.

8040 (CRN-PN—86-21) **Experimental study and analysis of emission of correlated fragments in the Kr+Au reaction at 35 and 44 MeV by nucleon.** Kamili, A. (Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires). Jul 1986. 97p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751374/JAW.

The Kr+Au reaction has been studied at 35 and 45 MeV per nucleon. Single and coincident fragments emitted in the forward direction were detected in six modules from the "XYZt" multidetector inside the Nautilus chamber at Ganil. Analysis of the energy and angle correlations allows to distinguish two mechanisms related to coincident fragments dependings whether these have a relative energy greater or equal to their coulomb repulsion. In a first mechanism, fragments are issued from two sources of different nature; a fast fragment is identified as the projectile-like while the slow coincident fragment is emitted from the highly excited target-like. In the second mechanism, fragments are created from an unique source, the slowed down projectile. The observed multiplicities, greater than two, show the existence of multifragmentation process.

8041 (INIS-SU—431, pp 69) **Rotational states in /sup 95/Te.** Begzhanov, R.B.; Khodzhaev, M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8042 (INIS-SU—431, pp 70) **Investigation of the /sup 96/Tc (T/sub 1/2/=52 min).** Ageev, V.A.; Velyavenko, B.S.; Zheltonozhskij, V.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8043 (INIS-SU—431, pp 72) **Lifetime of /sup 99/Ru energy levels, determined by dsa method.** Pasternak, A.A.; Kudoyarov, M.F.; Rassadin, L.A.; Zhovliev, U.J. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8044 (INIS-SU—431, pp 73-74) **Investigation of low-lying levels of nuclei in excitation by neutrons.** Demidov, A.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8045 (INIS-SU—431, pp 76) **Investigation of radiation from the /sup 103/Rh(n,γ)/sup 104/Rh reaction and /sup 104/Rh nucleus energy levels.** Kondurov, I.A.; Loginov, Yu.E.; Sushkov, P.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8046 (INIS-SU—431, pp 79-80) **/sup 109/Cd energy levels populated in the /sup 109/Ag(p,nγ) reaction.** Vishnevskij, I.N.; Dej, Yu.A.; Kirichenko, M.Yu.; Lobach, Yu.N.; Tkachuk, I.P.; Trishin, V.V.; Chaplitskaya, T.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8047 (INIS-SU—431, pp 83) **Lifetime of /sup 110/Ag excited states.** Kondurov, I.A.; Loginov, Yu.E.; Martynov, V.V.; Sushkov, P.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8048 (INIS-SU—431, pp 85-86) **/sup 115/Sn gamma rays from the /sup 115/In(p,nγ) reactions.** Vishnevskij, I.N.; Lobach, Yu.N.; Mel'nikov, O.B.; Tkachuk, I.P.; Trishin, V.V.; Chaplitskaya, T.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8049 (INIS-SU—431, pp 86) **Beta decay energy of /sup 118/In and /sup 120/In short-lived isomers.** Ganbaatar, N.; Veselov, G.V.; Mezilev, K.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8050 (INIS-SU—431, pp 88) **Investigation of the /sup 119m/Sn isomeric state decay.** Zhirgulyavichyus, R.K.; Dragunas, A.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8051 (INIS-SU—431, pp 91) **Investigation of pair conversion of /sup 124/Te gamma rays.** Metskhvarishvili, R.Ya.; Miminoshvili, Z.N.; Ehlizbarashvili, M.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8052 (INIS-SU—431, pp 92) **On the 2/sub 3//sup +/ and 3/sub 1//sup +/ levels at energy of 2039 keV in /sup 124/Te.** Govr, L.I.; Demidov, A.M.; Mikhajlov, I.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8053 (INIS-SU—431, pp 93) **Multipole mixture in /sup 126/Te γ-transitions from the (n,n'γ).** Berendakov, S.A.; Govor, L.I.; Demidov, A.M.; Mikhajlov, I.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8054 (INIS-SU—431, pp 94) **Multipole mixture in /sup 130/Te γ-transitions.** Berendakov, S.A.; Govor, L.I.; Demidov, A.M.; Mikhajlov, I.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8055 (INIS-SU—431, pp 242) **Motion of double energy peak in /sup 125m/Te gamma spectra.** Alpatov, V.G.; Bizina, G.E.; Godovikov, S.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8056 (INIS-SU—431, pp 246) **Effects of beta-decay strength function structure in delay proton spectra.** Alkhazov, G.D.; Batist, L.Kh.; Bykov, A.A.; Vitman, V.D.; Moroz, V.F.; Orlov, S.Yu.; Tarasov, V.K. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8057 (INIS-SU—431, pp 98) **Investigation of the /sup 138/Nd (T/sub 1/2/=5.2h) radiation.** Baratova, M.A.; Gromov, K.Ya.; Islamov, T.A.; Islamova, Kh.M.; Kalinnikov, V.G.; Kononenko, G.A.; Marupov, N.Z.; Makhmud Abdililakh. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8058 **$^{102}$Ru(p,d) $^{101}$Ru reaction at 26.3 MeV.** Dickey, S.A.; Kraushaar, J.J.; Rumore, M.A. (Colorado Univ., Boulder, USA. Nuclear Physics Lab.). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 8, 745-755(Aug 1986).

The $^{102}$Ru(p,d) $^{101}$Ru reaction was studied at a proton energy of 26.3 MeV. Angular distributions were obtained for outgoing deuterons to 26 states in $^{101}$Ru up to an excitation energy of 2.3 MeV. The results were compared with DWBA calculations to extract l values, spectroscopic factors and occupation probabilities.

## 6518 Nuclear Properties And Reactions, A=150-189, Experimental

8059 (INIS-SU—431, pp 236) **Detection of internal conversion γ-963keV K-line shift due to the atom ionization after electron capture in /sup 152m/Eu.** Bulgakov, V.V.; Gavrilyuk, V.I.; Kirishchuk, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

## 6519 Nuclear Properties And Reactions, A=190-219, Experimental

8060 (INIS-SU—431, pp 248) **Experimental study of internal bremsstrahlung accompanying /sup 203/Hg beta decay.** Shumejko, A.P.; Sushkov, A.A.; Dubov, V.P. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

## 6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

8061 (INIS-SU—431, pp 87) **Indium and francium short-lived isotope yields from the UC/sub x/ target at IRIS set.** Lemeshko, G.G.; Mezilev, K.A.; Novikov, Yu.N.; Panteleev, V.N.; Popov, A.V.; Sergeev, Yu.Ya.; Tikhonov, V.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8062 (INIS-SU—431, pp 244) **Determination of L-fluorescence yields of Np atoms.** Sergienko, B.A.; Ezhov, V.V. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

## 6530 Nuclear Theory

*REFER ALSO TO CITATION(S) 7923, 7927, 7953, 7955, 8002, 8020, 8152, 8182*

8063 **(BNL—40290) Shell model transition densities for electron and pion scattering.** Millener, D.J. (Brookhaven National Lab., Upton, NY (USA); Los Alamos National Lab., NM (USA)). 1987. Contract AC02-76CH00016. 25p. (CONF-8708102—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001557/JAW.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

The general features of an effective interaction suitable for the calculation of cross-shell matrix elements in the $^{16}$O region are discussed. Shell-model transition densities are applied to the 1 hw excitation of non-normal parity states in light-nuclei, with $^{12}$C used as a prime example. The longitudinal form factors from such a calculation require enhancement and transverse form factors (spin-excitations) need to be quenched. The shapes of form factors also exhibit systematic discrepancies which are correlated with the discrepancies in magnitude. The problem with shapes is particularly marked for C1 form factors. It is shown that the addition of small components to the transition density, corresponding to the excitation of a single particle through two or three major shells, works in the right direction as far as both magnitude and shape are concerned and that such additions are particularly effective in the case of C1 excitations. For the transverse form factors in $^{12}$C, the use of Woods-Saxon radial wave functions leads to reductions of up to 50% compared with harmonic oscillator wave functions. The excitation of states with dominant multiparticle-multihole components, and the role played by admixtures of such configurations in low-lying states, is considered. Some of the problems associated with the use of shell-model bases extended to include high-lying configurations in the giant resonance region are pointed out. 15 refs., 15 figs., 1 tab.

8064 **(BNL—40327) Antinucleon-nucleus interactions.** Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 21p. (CONF-8709160—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002119/JAW.

From 4. LEAR workshop; Villars-sur-Ollon, Switzerland (6 Sep 1987).

Recent experimental and theoretical results on anti p-nucleus interactions are reviewed. We focus on determinations of the anti p optical potential from elastic scattering, the use of (anti p, anti p') inelastic scattering to reveal aspects of the spin-isospin dependence of N anti N amplitudes, and some puzzling features of (anti p, anti n) charge exchange reactions on nuclei. 47 refs., 7 figs.

8065 **(BNL—40369) Ultra-relativistic heavy ion collisions in a multi-string model.** Werner, K. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-8708166—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002123/JAW.

From 6. international conference on ultrarelativistic nucleus-nucleus collisions; Nordkirchen, F.R. Germany (24 Aug 1987).

We present a model for ultra-relativistic heavy ion collisions based on color string formation and subsequent independent string fragmentation. Strings are formed due to color exchange between quarks at each individual nucleon nucleon collision. The fragmentation is treated as in $e^+e^-$ or lepton nucleon scattering. Calculation for pp, pA, and AA were carried out using the Monte Carlo code VENUS for Very Energetic Nuclear Scattering (version 1.0). 20 refs., 6 figs.

8066 **(CALT—63-462) Double beta decay and nuclear structure.** Vogel, P. (California Inst. of Tech., Pasadena (USA). Dept. of Physics). 1986. Contract AS03-81ER40002. 8p. (CONF-860167—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001966/JAW.

From Recontres de Moriond workshop on massive neutrinos in particle physics and astrophysics; Tignes, Savoie, France (25 Jan 1986).

The decay rate of the 2 nu double beta decay is calculated as a test of our understanding of the nuclear structure problems involved. The effects of pairing, static quadrupole deformation, spin-isospin polarization, and the $\Delta$ isobar admixtures are analyzed. The calculation, which is parameter free, predicts a faster decay rate than has been observed experimentally in $^{82}$Se, $^{130}$Te, and $^{150}$Nd. 4 refs., 3 figs., t tab.

8067 **(CALT—63-472) Nuclear structure and double beta decay.** Vogel, P. (California Inst. of Tech., Pasadena (USA). Dept. of Physics). 1986. Contract AS03-81ER40002. 8p. (CONF-8606205—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002288/JAW.

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

The nuclear matrix element for 2 nu double beta decay is calculated within the Quasiparticle Random Phase Approximation. It is found that the particle-particle component of the spin-isospin polarization force, which was neglected in previous calculations, plays an important role. It is shown that the decay matrix element passes through zero as a function of the corresponding interaction strength, g/sup pp/. More importantly, the analysis of EC/$\beta^+$ decay rates for semi-magic neutron-deficient nuclei suggests values for g/sup pp/ in the very vicinity of this zero, thereby yielding long lifetimes and providing a possible resolution of the longstanding discrepancy between calculated and measured 2 nu double beta decay rates. However, this also means that the $\beta\beta$ decay matrix element is a very sensitive quantity and difficult to predict reliably. The qualitative features of nuclear $\beta\beta$ decay are illustrated with the example of an exactly soluble model. 13 refs., 1 fig., 1 tab.

8068 **(CALT—63-477) Double beta decay in $^{136}$Xe.** Thomas, J.; Iqbal, M.Z. (California Inst. of Tech., Pasadena (USA)). 1986. Contract AS03-81ER40002. 7p. (CONF-8606205—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002286/JAW.

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

We are building two detectors to study double beta decay in $^{136}$Xe. Both detectors will be sensitive to decays with lifetimes $>5 \times 10^{22}$ years. 7 refs., 4 figs., 1 tab.

8069 **(CALT—63-490) Theory of double beta decay.** Vogel, P. (California Inst. of Tech., Pasadena (USA). Dept. of Physics). 1986. Contract AS03-81ER40002. 4p. (CONF-860701—90). NTIS, PC A02. Order Number DE88002285/JAW.

From 23. international conference on high-energy physics; Berkeley, CA, USA (16 Jul 1986).

The nuclear matrix elements for 2 nu double beta decay is calculated. It is shown that the decay matrix element passes through zero as a function of the coupling constant, g/sup pp/, of the particle-particle component of the spin-isospin polarization force, neglected previously. The analysis of EC/$\beta^+$ decay rates for semi-magic nuclei suggests values for g/sup pp/ in the very vicinity of this zero, thereby yielding long lifetimes and providing a possible resolution of the longstanding discrepancy between calculated and measured 2 nu double beta decay rates. 8 refs., 2 figs.

8070 **(DOE/ER/04928—T1) Scattering in a spherical potential motion of complex plane poles and zeros.** Arndt, R.A.; Roper, L.D. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Physics). 1987. Contract AS05-76ER04928. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002176/JAW.

Scattering of spinless nucleons in a spherical potential is examined with the use of a computer graphics simulation VSCAT. The potential is defined stepwise and the Schroedinger equation is solved to obtain wavefunctions, scattering phases, partial-wave total cross sections and differential cross sections, which are then displayed graphically. For the particular case of a square well, partial-wave amplitudes are displayed over the complex energy plane in a 3-dimensional plot. The well depth is then varied in order to follow the motion of poles as they become resonances and then bound states. Also displayed are the partial wave zeros, which are required to satisfy Levinson's theorem for multiple bound states. We develop the requirement on well depth to produce a specified number of bound states and enumerate the energies which, at a given well depth, create equal scattering phases in adjoining partial waves $\delta$/sub l-1/ = $\delta$/sub l/ = $\delta$/sub l+1/. This symmetry of scattering phases exists for both repulsive and attractive square potentials. We also briefly study a square repulsive core, which has the same triple-point symmetry as the square well. 9 figs.

8071 **(DOE/ER/40143—4) Theoretical studies in few-body intermediate energy physics: Progress report, October 1986-September 1987.** Mizutani, T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Oct 1987. Contract FG05-84ER40143. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002789/JAW.

The problem of coupled $\pi$NN-NN processes has been investigated, as well as low energy N anti N interactions. Proposed research in these areas is described, as well as $\gamma$d $\rightarrow$ np and $\pi$NN at the delta resonance region and K-d interactions. (LEW)

8072 **(DOE/ER/40315—144) The four fermion weak interaction and the decay of $^4$J He and $^5\lambda$ He: Status report.** Barnes, P.D.; Bart, S.; Bassalleck, B.; Chrien, R.E.; Diebold, G.E.; Franklin, G.B.; Hungerford, E.V.; McCrady, R.; Pile, P.; Quinn, B. (Carnegie-Mellon Univ., Pittsburgh, PA (USA); Brookhaven National Lab., Upton, NY (USA); Houston Univ., TX (USA); Kyoto Sangyo Univ. (Japan); New Mexico Univ., Albuquerque (USA); Vassar Coll., Poughkeepsie, NY (USA)). Oct 1987. Contract FG02-87ER40315. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001732/JAW.

This paper summarizes the research being done at Carnegie-Mellon University on four fermion weak interactions and the decay of $^4$AHe and $^5$AHe. Topics discussed are partial decay rates and spin-isospin dependence of the weak hamiltonian and the status of the $^{12}\Lambda$C lifetime experiment. 11 refs., 3 figs., 2 tabs.

**6073** **(INIS-mf—11071) Analysis of the pair structure of interacting bosons.** Winter, L.C. de. (Rijksuniversiteit Utrecht (Netherlands)). 12 May 1987. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700815/JAW.

Includes summary in Dutch.

This thesis deals with the microscopic foundation of the interacting-boson model (IBM) which can be applied to deformed (medium) heavy nuclei. These are examined microscopically by calculating observables with the Hartree-Fock-Bogoliubov (HFB) method on the basis of a fermion-pair description and investigating the differences between them and expectation values with respect to coherent wavefunctions in boson space. In ch. 2 the technique of computing energies and wavefunctions in the intrinsic frame is explained in detail. These computations are performed by constructing recurrence relations for the expectation values of observables as well as by the HFB method. Also results are presented of calculations in the collective-pair space where the pairs interact via a model hamiltonian. In ch. 3 the HFB method is applied to a realistic case. The structure of the collective pairs is determined for the nucleus /sup 156/Gd. The intrinsic K/sup $\pi$/=0/sup +/, 1/sup +/ and 2/sup +/-bands are investigated by performing Hill-Wheeler calculations in the corresponding dynamical variables. In ch. 4 the boson mapping of the microscopically determined observables is treated. In the first part of the chapter a mapping of the fermion problem onto the boson problem (the Dyson mapping) is investigated in the coherent-state formalism. The second part describes the determination of the IBM parameters via a mapping of potential-energy surfaces and via a fit of the energy levels. 111 refs.; 23 figs.; 10 tabs.

**6074** (INIS-SU—431, pp 54) **On difference of isobaric analog state energies and parent nucleus levels.** Inopin, E.V.; Korda, L.P.; Kopanets, E.G. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

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8129 (INIS-SU—431, pp 199) **Calculation of double $\beta$ decay lifetimes of /sup 76/Ge, /sup 82/Se, /sup 128/, /sup 130/Te nuclei.** Aliev, T.M.; Kuliev, A.A.; Salamov, D.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8130 (INIS-SU—431, pp 226) **Effect of atomic shell reconstruction on $\beta$-spectrum shape.** Batkin, I.S.; Demakov, S.L.; Churakova, T.A. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8131 (INIS-SU—431, pp 228) **To determination of G/sub v//sup 12/ from 0/sup +/->0/sup +/ $\beta$ decays.** Drukarev, E.G.; Strikman, M.I. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8132 (INIS-SU—431, pp 230) **Polarized nucleus beta decay with account of neutrino mass.** Kerimov, B.K.; Ehl'gavkhari, A.I.; Tajsir Mualla. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8133 (INIS-SU—431, pp 243) **Probability of $\beta$-decay in Hartree-Fock-Dirac atomic model and effect of chemical surrounding on $\beta$-decay.** Band, I.M.; Listengarten, M.A.; Trzhaskovskaya, M.B. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8134 (IPNO-TH—86-78) **Coulomb sum rules in the relativistic Fermi gas model.** Do Dang, G.; Orden, J.W. Van; L'Huillier, M.; Nguyen Giai, Van. (Paris-11 Univ., 91 - Orsay, France. Laboratoire de Physique Theorique et Hautes Energies; Maryland Univ., College Park, USA). (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Nov 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751396/JAW.

Coulomb sum rules are studied in the framework of the Fermi gas model. A distinction is made between mathematical and observable sum rules. Differences between non-relativistic and relativistic Fermi gas predictions are stressed. A method to deduce a Coulomb response function from the longitudinal response is proposed and tested numerically. This method is applied to the /sup 40/Ca data to obtain the experimental Coulomb sum rule as a function of momentum transfer.

8135 (IPNO-TH—87-21) **Envelope method and its applications to nuclear scattering.** Da Silveira, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Apr 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751401/JAW.

Lectures given at the Institute of Nuclear Sciences, Belgrad (Yugoslavia).

When two nuclei collide elastically (above the Coulomb barrier) they give rise to a rather complicated angular distribution, in which one observes marked oscillations. This results generally, from an interference effect due to the wavemechanical nature of the collision process. There is a wide range of mechanisms responsible for the occurrence of interferences. So, to gain insight into the physics of the collision, one should be able to identify different scattering mechanisms from the angular distribution. We adopt a new way to decompose the angular distribution into interfering components. Rather than going through the partial-wave analysis, we look for the conditions under which the interfering components can be obtained directly from the data, i.e., without knowledge of the phase shifts. We use an inversion-like procedure: the envelope method. Applications are given. We analyse quantitatively the nuclear component obtained from the Ar+Sn data which results from scattering mechanisms taking place in the region when the nuclear and Coulomb forces approximately balance each other.

8136 (IPNO-TH—87-33) **Nuclear collective states at finite temperature.** Milian, A.; Barranco, M.; Mas, D.; Lombard, R.J. (Barcelona Univ., Spain; Orleans Univ., 45, France). (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Apr 1987. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751402/JAW.

The Energy Density Method (EDM) has been used to study low-lying nuclear collective states as well as isoscalar giant resonances at finite temperature (T). Giant states have been studied by computing the corresponding strength function moments (sum rules) in the Random-Phase Approximation (RPA). For the description of the low lying states we have resorted to a variety of models from the rather sophisticated RPA method to liquid drop and schematic models. It has been found that low lying states are most affected by thermal effects, giant resonances being little affected in the range of temperatures here studied.

8137 (ISN—87-19) **Wigner-Kirkwood expansion of the phase-space density for half infinite nuclear matter.** Durand, M.; Schuck, P.; Vinas, X. (Grenoble-1 Univ., 38, France. Inst. des Sciences Nucleaires; Barcelone Univ., Spain). (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jan 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751405/JAW.

The phase space distribution of half infinite nuclear matter is expanded in a Planck constant-series analogous to the low temperature expansion of the Fermi function. Besides the usual Wigner-Kirkwood expansion, oscillatory terms are derived. In the case of a Woods-Saxon potential, a smallness parameter is defined, which determines the convergence of the series and explains the very rapid convergence of the Wigner-Kirkwood expansion for average (nuclear) binding energies.

8138 **(ISN—87-51) Resonating group method in an harmonic oscillator basis.** Silvestre-Brac, B.; Gignoux, C.; Ayant, Y. (Institut des Sciences Nucleaires, 38 - Grenoble, France; Grenoble Univ., 38 - Saint-Martin d'Heres, France. Laboratoire de Spectrometrie Physique). (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). May 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751409/JAW.

The scattering states for a general many body system is formulated within the resonating group method. The resulting Lippman-Schwinger equation is solved in an harmonic oscillator basis for which a number of advantages are emphasized. The analytical formula giving the free propagator in that basis is fully derived.

8139 **(ISN—87-61) Nuclear elasticity applied to giant resonances of fast rotating nuclei.** Jang, S.; Bouyssy, A. (Institut des Sciences Nucleaires, 38 - Grenoble, France; Paris-11 Univ., 91 - Orsay, France. Institut de Physique Nucleaire). (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751410/JAW.

Isoscalar giant resonances in fast rotating nuclei are investigated within the framework of nuclear elasticity by solving the equation of motion of elastic nuclear medium in a rotating frame of reference. Both Coriolis and centrifugal forces are taken into account. The nuclear rotation removes completely the azimuthal degeneracy of the giant resonance energies. Realistic large values of the angular velocity, which are still small as compared to the giant resonance frequencies, are briefly reviewed in relation to allowed high angular momenta. It is shown that for the A=150 region, the Coriolis force is dominating for small values ($< \sim 0.05$) of the ratio of angular velocity to resonance frequency, whereas the centrifugal force plays a prominent part in the shift of the split resonance energies for larger values of the ratio. Typical examples of the resonance energies and their fragmentation due to both rotation and deformation are given.

8140 **(LA-UR—87-3367) Pion single- and double-charge-exchange reactions at low energies.** Baer, H.W. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 26p. (CONF-8706166—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001841/JAW.

From International symposium on medium energy physics; Beijing, China (23 Jun 1987).

The general features of pion charge-exchange reactions at energies of 20 to 80 MeV leading to nuclear isobaric-analog states (IAS) and double-isobaric-analog states (DIAS) are reviewed. The recent progress achieved in understanding the role of short-range N-N correlations in the double-charge-exchange reactions is presented. 36 refs., 21 figs., 2 tabs.

8141 **(LA-UR—87-3387) Nucleon-nucleon correlations detected via pion double-charge-exchange reactions.** Bleszynski, E.; Bleszynski, M.; Glauber, R.J. (California Univ., Los Angeles (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); Harvard Univ., Cambridge, MA (USA). Lyman Lab. of Physics). 1987. Contract W-7405-ENG-36. 14p. (CONF-8708102—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001839/JAW.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

Double-charge-exchange reactions induced by pions are shown to furnish a direct means of detecting nucleon-nucleon correlations in nuclei. For the particular case of double isobaric analog transitions the effect of correlations is easily isolated and quite strong. Examination of the properties of the position correlations implicit in the nuclear shell model provides an explanation of several experimentally observed features of double-charge-exchange reactions, including in particular, their dependence on the number of valence neutrons present. An explicit demonstration of the role played by nucleon-nucleon correlations is presented for the double-charge-exchange cross-sections of $^{42}$Ca, $^{44}$Ca and $^{48}$Ca, recently measured at LAMPF. Our analysis explains why the cross section for the double-charge-exchange reaction on $^{48}$Ca, in which 28 neutron pairs participate, is comparable and indeed smaller than the corresponding cross-section for $^{42}$Ca with its single valence neutron pair. It also predicts the variation of angular distributions over the family of isotopes. 13 refs., 3 figs.

8142 **(UCRL—96381) Predictions for nuclear properties along the r-process path.** Aprahamian, A. (Lawrence Livermore National Lab., CA (USA)). 15 Oct 1987. Contract W-7405-ENG-48. 10p. (CONF-870802—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001884/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The uniformity of different nuclear regions as a function of the number of valence protons and neutrons (counted from the nearest closed shell) has been exploited for the parameterization of calculations for nuclei far from stability within the IBA model. Predictions are given for low lying levels, E2 transition rates, and binding energies for nuclei in the r-process path in the A = 150 and A = 190 mass regions. 6 refs., 6 figs.

8143 **Quest for quark soup.** Goldhaber, J. (Lawrence Berkeley Lab., CA, USA). *New Scientist (London);* **112**: No. 1534, 40-43(13 Nov 1986).

The paper concerns the experimental search for quark-gluon plasma. The theory of a quark-gluon plasma is first given. Then the method which researchers hope will create the quark-gluon plasma is described; the idea is to use heavy ion beams in, the CERN SPS. The CERN 'heavy-ion programme' involves research groups mainly from CERN, Lawrence Berkeley Laboratory and Gellselschaft fuer Schwerionenforschung. The experiments in the research programme are outlined, together with the detector equipment employed in the experiments.

8144 **Formation of antimatter clusters in the hadronisation phase transition.** Heinz, U.; Subramanian, P.R.; Stoecker, H.; Greiner, W. (Brookhaven National Lab., Upton, NY, USA; Frankfurt Univ., Germany, F.R. Inst. fuer Theoretische Physik). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 11, 1237-1263(Nov 1986). Contract AC02-76CH00016.

The question of how quarks and antiquarks hadronise in the phase transition from a quark-gluon plasma to a hadron resonance gas is discussed. Chemical equilibrium between the different hadronic species in the hadronic phase and the quarks in the plasma phase is employed to determine their relative abundances in a simple model, where the phase transition happens fast and the quark and antiquark contents of the plasma phase are completely carried over into the hadronic phase. Global expansion of the matter and reheating during the phase transition are neglected. Under these conditions the chance to form an anti-alpha nucleus at the phase transition point in a system with zero baryon number is about two orders of magnitude higher than in an equilibrium hadron gas with the same temperature.

8145 **Collectivity: a comparison of collective model, Nsub(p)Nsub(n) and F-spin approaches with empirical systematics.** Casten, R.F.; Brentano, P. von; Gelberg, A.; Harter, H. (Brookhaven National Lab., Upton, NY, USA; Koeln Univ., Germany, F.R. Inst. fuer Kernphysik). *Journal of Physics F (London). Metal Physics (London);* **12**: No. 8, 711-716(Aug 1986). Contract AC02-76CH00016.

Isodeformation contours obtained from collective model calculations, from the Nsub(p)Nsub(n) scheme and from a schematic F-spin invariant interacting boson model are compared with empirical systematics in the $50<=Z<=82, 82<=N<=126$ shells. The comparison shows the relationships among these different approaches and their respective advantages and limitations.

8146 **Contribution of exchange currents to the elastic $\pi$D scattering in the $\Delta_{33}$ resonance region.** Anjos, J.C.; Levy, D.; Simao, F.R.A.; Wulck, S. (Fermi National Accelerator Lab., Batavia, IL, USA; CFA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France. Service de Physique Theorique; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Rio de Janeiro Univ., Brazil. Inst. de Fisica). *Journal of Physics F (London). Metal Physics (London);* 12: No. 7, 599-608(Jul 1986).

Feynman diagrams are used to calculate the contributions of the pion exchange currents to the $\pi D \rightarrow \pi D$ scattering in the region where the $\Delta_{33}$ resonance is dominant. The results show that the contributions to the differential cross section, although small, are comparable with that of the double scattering.

8147 **Pion-nucleus double charge exchange: the modern era.** Baer, H.W.; Miller, G.A. (Los Alamos National Lab., NM, USA; Washington Univ., Seattle, USA. Inst. for Nuclear Theory). *Comments on Nuclear and Particle Physics;* 15: No. 6, 269-293(Apr 1986).

The paper concerns highlights and new trends from the recent LAMPF workshop (Jan 1985) on pion-nucleus double charge exchange (DCX). Reaction mechanisms for DCX, charge exchange at pion energies near 50MeV, energies above the $\Delta$ -resonance region, the $\Delta$-resonance region 100 to 220 MeV, and inclusive DCX, are all discussed.

8148 **Effect of self-consistent treatment of one-gluon exchange in the Freidberg-Leenor-topological soliton model.** Haider, Q.; Liu, L.C. (Los Alamos National Lab., NM, USA). *Journal of Physics F (London). Metal Physics (London);* 12: No. 3, L75-L81(Mar 1986). Contract W-7405-ENG-36.

The effects of one-gluon exchange on the static properties of ground-state hadrons have been examined in detail within the framework of Friedberg-Lee non-topological soliton model. It is noted that the perturbative approach, employed in many bag models, is inadequate. A self-consistent non-perturbative procedure for calculating one-gluon exchange is proposed.

8149 **Mean-field repulsion of colliding nuclear matter at relativistic energies.** Mueller, K.H.; Bohrmann, S. (Lawrence Berkeley Lab., CA, USA). *Journal of Physics F (London). Metal Physics (London);* 12: No. 2, L57-L61(Feb 1986). Contract W-7405-ENG-48.

A study is made of the energy behaviour of two penetrating interacting nuclear matter systems in a relativistic quantum field theory proposed by J D Waleck (1974 Ann. Phys., NY83, 491). It is shown that, compared with non-interacting systems, the relative flow velocity is significantly reduced due to the repulsive $\omega$-meson field and an effective potential between the matter systems is discussed.

8150 **Sequential stripping aspects of ($\alpha$,d) and (t,p) two-nucleon transfer.** Daehnick, W.W. (Nuclear Physics Lab., Univ. of Pittsburgh, Pittsburgh, PA 15260). pp 319-340 of Proceedings of the Tsukuba international workshop on deuteron involving reactions and polarization phenomena. Aoki, Y.; Yagi, K. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8508181—).

From International workshop on deuteron involved reaction and polarization phenomena; Tsukuba, Japan (22 Aug 1985).

Experimental evidence for higher order effects in two-nucleon transfer is reviewed. Some systematic effects are found for pure multiplets. Data are compared with first order finite range calculations and first plus second order DWBA calculations in the zero-range approximation.

8151 **Polarization transfer in (d-vector,p-vector) reactions.** Weitkamp, W.G. (Nuclear Physics Lab., Univ. of Washington, Seattle, WA 98195). pp 133-149 of Proceedings of the Tsukuba international workshop on deuteron involving reactions and polarization phenomena. Aoki, Y.; Yagi, K. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8508181—).

From International workshop on deuteron involved reaction and polarization phenomena; Tsukuba, Japan (22 Aug 1985).

Measurement of polarization transfer coefficients in (d/sup $\rightarrow$/,p/sup $\rightarrow$/) reactions is reviewed. Measurements have been made to provide information on the structure of light nuclei, to look for violations of the charge symmetry of nuclear forces, to study competition between evaporation and direct proton emission, to study deuteron breakup and to demonstrate effects of the deuteron D state in (d/sup $\rightarrow$/,p/sup $\rightarrow$/) reactions. Possible new measurements are suggested.

## 6540 Radiation And Shielding Physics

8152 **(LA-UR—87-3337) Neutron secondary-particle production cross sections and their incorporation into Monte-Carlo transport codes.** Brenner, D.J.; Prael, R.E.; Little, R.C. (Columbia Univ., New York (USA). Radiological Research Lab.; Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-871020—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88001848/JAW.

From 6. symposium on neutron dosimetry; Neuherberg, F.R. Germany (12 Oct 1987).

Realistic simulations of the passage of fast neutrons through tissue require a large quantity of cross-sectional data. What are needed are differential (in particle type, energy and angle) cross sections. A computer code is described which produces such spectra for neutrons above ~14 MeV incident on light nuclei such as carbon and oxygen. Comparisons have been made with experimental measurements of double-differential secondary charged-particle production on carbon and oxygen at energies from 27 to 60 MeV; they indicate that the model is adequate in this energy range. In order to utilize fully the results of these calculations, they should be incorporated into a neutron transport code. This requires defining a generalized format for describing charged-particle production, putting the calculated results in this format, interfacing the neutron transport code with these data, and charged-particle transport. The design and development of such a program is described. 13 refs., 3 figs.

8153 **Progress in nodal methods for the solution of the neutron diffusion and transport equations.** Lawrence, R.D. (Argonne National Lab., IL, USA). *Progress in Nuclear Energy;* 17: No. 3, 271-301(1986).

Recent progress in the development of coarse-mesh nodal methods for the numerical solution of the neutron diffusion and transport equations is reviewed. In contrast with earlier nodal simulators, more recent nodal diffusion methods are characterized by the systematic derivation of spatial coupling relationships that are entirely consistent with the multigroup diffusion equation. These relationships most often are derived by developing approximations to the one-dimensional equations obtained by integrating the multidimensional diffusion equation over directions transverse to each coordinate axis. Both polynomial and analytic approaches to the solution of the transverse-integrated equations are discussed, and the Cartesian-geometry polynomial approach is derived in a manner which motivates the extension of this formulation to the solution of the diffusion equation in hexagonal geometry. Iterative procedures developed for the solution of the nodal equations are discussed briefly, and numerical comparisons for representative three-dimensional benchmark problems are given. The application of similar ideas to the neutron transport equation has led to the development of coarse-mesh transport schemes that combine nodal spatial approximations with angular representations based on either the standard discrete-ordinate approximation or double Psub(n) expansions of the angular dependence of the fluxes on the surfaces of the nodes. The former methods yield improved difference approximations to the multidimensional discrete-ordinates equations, while the latter approach leads to equations similar to those obtained in interface-current nodal-diffusion formulations. The relative efficiencies of these two approaches are discussed, and directions for future work are indicated.

8154 **Cf-source-driven neutron-noise measurements of subcriticality for a 4.95 wt% $^{235}$U-enriched uranyl fluoride solution cylinder.** Mihalczo, J.T.; Kryter, R.T.; King, W.T.; Blakeman, E.D. (Oak Ridge National Lab., TN, USA). *Annals of Nuclear Energy;* 13: No. 7, 351-362(1986).

A method for determining the reactivity of subcritical systems of fissile material, using neutron-noise power spectral density measurements in conjunction with a $^{252}$Cf source, has been tested in experiments with an aqueous solution containing uranium fluoride (4.95 wt% $^{235}$U). The kappasub(eff)-values obtained from the ratio of spectral densities $G^*_{12}G_{13}/G_{11}G_{23}$ agreed with those from break-frequency noise analysis and with bias-corrected transport theory calculations within the statistical uncertainty of the measurements. Corrections for the effects of spatial modes and source-detector locations appear to be well-understood, since measurements for a variety of source-detector positions resulted in essentially the same kappasub(eff)-values. Modal correction factors were such that ignoring them would result in higher values of kappasub(eff) than actually occur. The measurements have demonstrated the applicability of the $^{252}$Cf-source-driven neutron-noise analysis method to the measurement of the subcritical neutron multiplication factor for a fuel solution system.

## 6550 Medical Physics

*REFER ALSO TO CITATION(S) 7467, 7782, 7783, 7908*

8155 **(ARL/TR—076) Annual review of research projects 1985.** Keam, D.W. (ed.). (Australian Radiation Lab., Melbourne). Apr 1987. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700782/JAW.

This progress report provides a brief outline of current Laboratory research and development projects and their present status. The material has been grouped into the following fields: uranium, radon and its daughters; radiation effects in solids and gases; x-rays and clinical dosimetry, measurement standards in radiation dosimetry; radiopharmaceuticals and nuclear medicine; non-ionising electromagnetic radiation; environmental radiochemistry and radiation monitoring. The last category includes residual radioactive contamination at Maralinga, Emu and the Monte Bello Islands from British nuclear weapons tests in Australia, and the public health impact of fall-out from those tests.

8156 **(ARL/TR—077) Response of lithium fluoride impregnated teflon discs to $\beta$ radiation below 2 MeV.** Danby, R.J. (Australian Radiation Lab., Melbourne). May 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700783/JAW.

This report describes the response of LiF-7 teflon discs to $\beta$-radiation below 2 MeV and considers the suitability of this form of thermoluminescent dosimetry (TLD) material as a possible sensitive element for the proposed ARL extremity monitor. Laboratory tests were undertaken to determine the sensitivity of the TLD material as a function of $\beta$-energy, and as a function of dose. The effect of bremsstrahlung radiation and its contribution to a measured skin dose was also considered. The $\beta$ sensitivity of the teflon discs was also compared to the sensitivity of the discs to /sup 137/Cs $\gamma$-rays.

8157 **(CEPN—100) What is Alara.** Oudiz, A.; Lochard, J.; Lombard, J.; Croft, J. Fleishman, A.; Webb, G. (Centre d'Etude sur l'Evaluation de la Protection dans le domaine Nucleaire, 92 - Fontenay-aux-Roses, France; National Radiological Protection Board, Harwell, UK). (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751365/JAW.

The system of dose limitation recommended by the International Commission on Radiological Protection formulates three radiation protection principles: 1) the so-called justification principle which states that no practice shall be adopted unless its introduction produces a positive net benefit; 2) the so-called optimisation principle which states that all exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account; 3) the limitation of individual dose which insures that the dose equivalent to an individual shall not exceed the limits recommended by the ICRP. Acknowledging the fact that these requirements are interrelated, this report is devoted to a presentation of the second principle, assuming that the two other ones are satisfied. As defined by ICRP, the optimisation principle is strictly equivalent with the commonly known ALARA principle (As Low As Reasonably Achievable). ALARA may be considered altogether as a guiding principle for radiological protection management, as well as a procedure allowing the implementation of this principle.

8158 **(CEPN—102) Cost benefit analysis cost effectiveness analysis.** Lombard, J. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751367/JAW.

The comparison of various protection options in order to determine which is the best compromise between cost of protection and residual risk is the purpose of the ALARA procedure. The use of decision-aiding techniques is valuable as an aid to selection procedures. The purpose of this study is to introduce two rather simple and well known decision aiding techniques: the cost-effectiveness analysis and the cost-benefit analysis. These two techniques are relevant for the great part of ALARA decisions which need the use of a quantitative technique. The study is based on an hypothetical case of 10 protection options. Four methods are applied to the data.

8159 **(CEPN—110) Decision analysis multicriteria analysis.** Lombard, J. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751369/JAW.

The ALARA procedure covers a wide range of decisions from the simplest to the most complex one. For the simplest one the engineering judgement is generally enough and the use of a decision aiding technique is therefore not necessary. For some decisions the comparison of the available protection option may be performed from two or a few criteria (or attributes) (protection cost, collective dose,...) and the use of rather simple decision aiding techniques, like the Cost Effectiveness Analysis or the Cost Benefit Analysis, is quite enough. For the more complex decisions, involving numerous criteria or for decisions involving large uncertainties or qualitative judgement the use of these techniques, even the extended cost benefit analysis, is not recommended and appropriate techniques like multi-attribute decision aiding techniques are more relevant. There is a lot of such particular techniques and it is not possible to present all of them. Therefore only two broad categories of multi-attribute decision aiding techniques will be presented here: decision analysis and the outranking analysis.

8160 **(CEPN—113) Multicriteria analysis of public protection in PWR's.** Lombard, J. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751371/JAW.

In order to manage a risk efficiently and to reach the ALARA level of protection, the best possible protection options must be employed. As the available resources are limited, it is not always possible to choose those options that minimize the risk, therefore a compromise must be made between risks and safety expenses. When the choice is difficult or complex, finding such a compromise can be facilitated by resorting to a decision aiding method which allows the assessment of the respective advantages of the various protection options considered. The multicriteria methods employ successive comparisons. Instead of searching for a final indicator expressing the performance of each option they compare all option pairs in order to determine if the gap between their respective advantages and disadvantages is sufficient to estimate that one option of the each pair is better than the other. Instead of judging each option globally these methods evaluate the advantages and disadvantages associated with the eventual choice of an option as compared with the others. These differential and comparative approach gives more flexibility and allows the introduction of qualitative criteria. The method presented here (Electre 3), one of the most recent ones, allows a multicriteria comparison of a set of op-

tions keeping into account the uncertainties associated with the options or the preferences. In order to illustrate this method a simple example (4 options, 4 criteria) dealing with a PWR liquid releases treatment system, is taken up.

8161 **(IAEA-INFCIRC—344) Application of intervention dose levels and derived intervention levels in the event of a major nuclear accident: review of present status.** (International Atomic Energy Agency, Vienna (Austria)). Aug 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700795/JAW.

This information is based on the report submitted by the Secretariat to the IAEA Board of Governors, together with a summary of the advice and recommendations made by an IAEA Advisory Group which met in February 1987 to review the IAEA's existing guidance in the area of intervention dose levels and derived intervention levels. 7 refs, 3 tabs.

8162 **Composition of body tissues.** Woodard, H.Q.; White, D.R. (Department of Energy, Washington, DC, USA. Div. of Energy Storage Systems; Saint Bartholomew's Hospital, London, UK). *British Journal of Radiology;* **59**: No. 708, 1209-1218(Dec 1986).

A reassessment of the composition data given by ICRP (1975) has been completed, augmented with results from appropriate recent studies. The water, lipid, protein, carbohydrate and ash contents, together with elemental compositions, mass and electron densities are given here for 56 body tissues. Seven tissues (adipose tissue, heart, kidney, liver, mammary gland, muscle-skeletal and skin) had sufficient measured data to enable the spread in the results to be evaluated. All the compositions presented apply to healthy, adult humans, except for some new material on the bones of children.

8163 **Physical and biological dosimetry at the barium sulphate-culture medium interface.** Tokita, N.; Kogel, I. van der; Chmielewski, J.J.; Raju, M.R. (Los Alamos National Lab., NM, USA). *British Journal of Radiology;* **59**: No. 707, 1131-1133(Nov 1986).

The present study suggests that a thin layer of Barium sulphate suspension forms an interface with tissues which results in high dose regions on both sides of the BSS-tissue interface when irradiated with 250 kVp X rays. The magnitude of dose increase depends on the density of the BSS. (U.K.).

8164 **Thermoluminescence of $^{7}$LiF in therapeutic high linear energy transfer (LET) charged-particle beams.** Chu, C.L.; Hogstrom, K.R.; Chen, G.C.; Hilko, R.L. (Anderson, M.D. Hospital and Tumor Inst., Houston, TX, USA; Lawrence Berkeley Lab., CA, USA; New Mexico Univ., Los Alamos, US. Cancer Research and Treatment Center). *Physics in Medicine and Biology;* **31**: No. 2, 145-160(Feb 1986). Contract W-7405-ENG-48.

The thermoluminescence of the 200 and 260°C peaks of $^{7}$LiF has been measured and compared with off-axis dose and depth-dose distributions for three therapeutic high-LET beams: negative pions, helium ions and neon ions. The methods of analysis consisted of both a single-peak analysis and the dual-peak analysis methods of Hogstrom and Irifune and Hoffmann et al. The results indicate that $^{7}$LiF, analysed by the dual-peak analysis methods, is potentially useful for extracting total dose, high-LET dose, and beam quality of helium-ion and negative-pion beams. For the higher-LET neon beam, differences in sensitivity between the 200 and 260°C peaks of $^{7}$LiF were found to be independent of variations in LET within the beam; consequently, only the single-peak analysis method is applicable in which case the dosemeter at best can only estimate total dose.

8165 **Radiation dose from HPRR gamma rays.** Oyan, R.; Sims, C.S. (Oak Ridge National Lab., TN, USA). *Radiation Protection Dosimetry;* **16**: No. 3, 213-217(1986).

The gamma ray dose relative to distance has been experimentally obtained for four different shielding conditions of the Health Physics Research Reactor (HPRR) using Geiger-Mueller counters and TLD-700 dosemeters. The data have been analysed to yield shield gamma attenuation factors and analytic expressions for the dose-distance relationships for each shielding condition. Combining this information with previously determined neutron dose data has yielded neutron to gamma dose ratios for conditions of interest to most HPRR users. This is the most complete set of gamma dose information available for the internationally used HPRR.

## 6560 Condensed Matter Physics

*REFER ALSO TO CITATION(S) 7631, 7948*

8166 **(DOE/ER/45246—2) Study of the embedded atom method of atomistic calculations for metals and alloys: Progress report, March 1, 1987-February 28, 1988.** Johnson, R.A. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Nov 1987. Contract FG05-86ER45246. 11p. (UVA—527340/MS88/102). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002798/JAW.

The relationships between the physical input and output of the Embedded Atom Method (EAM) used in atomistic calculations for metals and alloys and the model functions and parameters are being investigated. An analytic fcc EAM model has been derived based on short range approximations to the input functions in EAM and has been studied both analytically and numerically for the fcc lattice. This model has been extended to longer ranges and applied to both fcc and hcp metals. The correspondence between models based on density functional theory (EAM), tight binding methods, and effective medium theory has been reported. The reasons for difficulty in applying EAM to bcc metals is under study and a new form of alloy potential which retains general properties of pure metal potentials has been developed. 8 refs.

8167 **(IAEA-R—3011-F) Application of positron annihilation method for the study of radiation defects and defects formed in other ways. Final report for the period December 1981 - December 1985.** Tumbev, G. (Bylgarska Akademiya na Naukite, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika). (International Atomic Energy Agency, Vienna (Austria)). Oct 1987. 117p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700797/JAW.

The radiation effects in ionic crystals (LiF, CaF2, BaF2 and AgCl) were studied using three positron annihilation techniques: Doppler broadening, life-time measurements and three-gamma annihilation. The irradiation with determined doses of gamma-rays was performed at controlled temperatures, and following specified annealing conditions. The measurements were also made at different temperatures. Different behaviour was observed for ionic crystals of different composition. The results were compared with observations made by other techniques, and with theoretical models. 55 refs, 61 figs, 11 tabs.

8168 (INIS-BR—897, pp 80) **Role of isoelectronic extrapolation of highly ionized atoms in plasma physics.** Trigueiros, A.G. (Universidade Estadual de Campinas, Sao Paulo, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8169 **(INIS-mf—11068) Use of dynamic nuclear polarization in /sup 1/H and /sup 13/C solid state NMR.** Duijvestijn, M.J. (Technische Hogeschool Delft (Netherlands)). 10 Sep 1985. 188p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE88700812/JAW.

Includes summary in Dutch.

The Dynamic Nuclear Polarization (DNP) effect is used at room temperature in combination with /sup 13/C NMR. Due to the low natural abundance of /sup 13/C spins (1%) the signal is very weak, but when the DNP effect is used the /sup 13/C signal can be enhanced and therefore the number of scans and the measuring time considerably reduced. The theory is presented and the experimental set-up is described. Experiments on polystyrene, artificially doped with free radicals are described and it is examined

whether the theory of the DNP effect can be used in a quantitative way. Applications of the use of the DNP effect in /sup 13/C NMR are shown. Excellent spectra are presented of artificial and natural diamonds, possibly to be used for diamond characterization purposes. 161 refs.; 61 figs.; 3 tabs.

8170 **(INIS-mf—11072) Structural determination of the carbohydrate chains from arthropod and mollusc hemocyanin by means of 500-MHz /sup 1/H-NMR spectroscopy.** Kuik, J.A. van. (Rijksuniversiteit Utrecht (Netherlands)). 1 Jun 1987. 118p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700816/JAW.

Includes summary in Dutch and previously published material.

In this thesis carbohydrate structures of hemocyanins of arthropods and molluscs are studied. Hemocyanins are high-molecular-mass, copper-containing oxygen-transport proteins. The function of these carbohydrate chains are yet still unknown. It is not probable that they play a role in the oxygen-binding processes. They are rather thought to have a function in the build-up of the hemocyanin molecules. 286 refs.; 30 figs.; 25 tabs.

8171 **(INIS-SU—431, pp 237) Electronic structure of Tc impurity atoms in alloys on the base of data of internal conversion electron spectra investigation.** Gerasimov, V.N.; Kulakov, V.M. 1987. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88780039/JAW. (CONF-8704221—).

From 37. All-Union conference on nuclear spectroscopy and nuclear structure; Yurmala, USSR (14 Apr 1987).

8172 **Ion implantation effects in alkali-borosilicate glasses.** Arnold, G.W. (Sandia National Labs., Albuquerque, NM, USA). *Radiation Effects;* **98**: No. 1-4, 55-61(Sep 1986). (CONF-8507164—).

From 3. international conference on radiation effects in insulators; Guildford, UK (15 Jul 1985).

Complex alkali-borosilicate glasses are being studied, and used, as media for radioactive waste encapsulation. The effects of radiation from $\alpha$-decay processes on the physical properties of such glasses is of interest. The energy deposited in the glass by such decay processes can be simulated by ion implantation. We have examined the effects of ion implantation (He, Ar, Xe) on $(1-x)M_2O.xB_2/_3.3SiO_2$(M=Na, K; x=O, 0.2, 0.4, 0.6, 0.8) glass through measurements of induced stress (due to changes in volume $\Delta V/V$) in the implanted glasses fabricated in the form of thin cantilever beams. These measurements show, as general features, (1) an initial expansion, over a fluence range governed by the alkali content, followed by compaction; (2) the maximum stress in the compaction regime is greatest for lowest alkali levels; and (3) the stress data scale with energy into electronic processes for the various ions and for all the glasses. The scaling of dilatation/stress with electronic deposition rather than energy into collisional processes suggest that the approx. 5 MeV $\alpha$-particle in radioactive waste decay processes may contribute significantly to the radiation damage accrued in the glass encapsulant.

8173 **Model calculation of two-dimensional angular correlation for positron annihilation at a metal surface.** Garner, J.; Benedek, R. (Argonne National Lab., IL, USA). *Journal of Physics F (London). Metal Physics (London);* **16**: No. 8, L165-L168(Aug 1986). Contract W-31-109-ENG-38.

A jellium model is applied to the calculation of the two-dimensional angular correlation (2D-ACAR) spectrum for positron annihilation from a surface state. The predicted anisotropy is compared with experimental results for Cu obtained by Howell.

8174 **Use of convergent-beam electron diffraction to determine local lattice distortions in nickel-base superalloys.** Kaufman, M.J.; Pearson, D.D.; Fraser, H.L. (Illinois Univ., Urbana, USA. Dept. of Metallurgy and Mining Engineering; Illinois Univ., Urbana, USA. Materials Research Lab.). *Philosophical Magazine, A: Defects and Mechanical Properties;* **54**: No. 1, 79-92(Jul 1986). Contract AC02-76ER01198.

Convergent-beam electron diffraction has been used to study local lattice distortions of $\gamma'$ (the ordered intermetallic compound based on $Ni_3Al$) in nickel-base alloys. The various results are interpreted on the basis of the observed distortions being caused by stresses which may be introduced by effects such as differing thermal expansion or contraction coefficients of the component phases and lattice mismatch. The effect of relaxations of these stresses by the proximity of the foil surfaces has been demonstrated. It is concluded that extreme caution should be exercised when this technique is used to make determinations of quantities such as lattice mismatch and coherency strains.

8175 **Note concerning the mean free path for convoy electron extinction in thin solid targets.** Sellin, I.A.; Burgdoerfer, J.; Berry, S.D.; Breinig, M.; Betz, H.D.; Groeneveld, K.O. (Tennessee Univ., Knoxville, USA; Oak Ridge National Lab., TN, USA; Muenchen Univ., Germany, F.R. Sektion Physik; Frankfurt Univ., Germany, F.R. Inst. fuer Kernphysik). *Journal of Physics B: Atomic and Molecular Physics;* **19**: No. 5, L155-L159(14 Mar 1986).

A unified interpretation is given of data obtained in two recent experiments which indicate that the mean free path (MFP) for convoy electron extinction lambdasub(c) by scattering in solids can be significantly larger than the MFP for free electrons of similar velocity. It is found that lambdasub(c) = alambdasub(e), where a approx. = 8-10 and lambdasub(c) is the inelastic MFP for free electrons. Coulomb focusing provided by a sufficiently highly charged projectile is a plausible explanation for the effect.

8176 **Observation of high-order electric multipoles in convoy electron angular distributions.** Berry, S.D.; Elston, S.B.; Sellin, I.A.; De Serio, R.; Gonzalez-Lepera, C.E.; Liljeby, L. (Tennessee Univ., Knoxville, USA; Oak Ridge National Lab., TN, USA). *Journal of Physics B: Atomic and Molecular Physics;* **19**: No. 5, L149-L154(14 Mar 1986).

The authors have discovered multipoles of even order up to about 10 in the multipole moments characterising angular distributions of convoy electrons ejected by swift ions during penetration of thin solids. It is suggested that the strongly transverse distributions observed reflect electron loss from excited n, l states inside the solid, which, though rapidly created and destroyed, progress toward finite dynamic equilibrium populations. Alternative interpretations are also discussed.

## 6561 Superconductivity

*REFER ALSO TO CITATION(S) 7618*

## 6570 Theoretical And Mathematical Physics

*REFER ALSO TO CITATION(S) 7931, 8070, 8138*

8177 **(BONN-IR—86-24) Hamiltonian formalism of the N=1 supergravity in one dimension.** Chaselon, P. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Jul 1986. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751265/JAW.

After having stated the Lagrangian function in a form restricted to one dimension we tried to develop the corresponding Hamiltonian formalism. We obtained the equations of motion together with the primary constraints. After we had a complete set of constraints we could perform by means of the Poisson brackets of Casalbuoni (1976) a classification into first-class and second-class conditions. The set of first-class conditions selected by us was maximal. The first-class conditions correspond to the invariance group of supergravity. We eliminated the second-class conditions by means of Dirac brackets. These led us automatically to a second-order formalism. Finally we show that the Hamiltonian of supergravity can be described as linear combination of first-class conditions. (orig./HSI).

8178 **(INP—1272/PH) Quantum mechanics with quantum time.** Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700827/JAW.

Published in 1985.

Using a non-canonical Lie structure of classical mechanics a new algebra of quantum mechanical observables is constructed. The new algebra, in addition to the notion of classical time, makes it possible to introduce the notion of quantum time. A new type of uncertainty relation is derived.

8179 **(LYCEN—8678) Dynamical invariance algebra of the Hartmann potential.** Kibler, M.; Winternitz, P. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Dec 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751422/JAW.

The "accidental" degeneracy occurring in the quantum-mechanical treatment of the ring-shaped potential given in the text is explained by constructing an su(2) dynamical invariance algebra. The Schroedinger equation is solved in parabolic coordinates written in the framework of the Kustaanheimo-Stiefel transformation and the Hamilton-Jacobi equations are solved in ordinary parabolic coordinates. All finite trajectories are found to be periodic. The Hartmann potential takes its origin in the quantum chemistry of ring shaped molecules.

8180 **More on d = 5 Maxwell-Einstein supergravity: symmetric spaces and kinks.** Gunaydin, M.; Sierra, G.; Townsend, P.K. (Lawrence Livermore National Lab., CA, USA; Lawrence Berkeley Lab., CA, USA; Universidad Complutense de Madrid, Spain. Facultad de Ciencias Fisicas; Cambridge Univ., UK. Dept. of Applied Mathematics and Theoretical Physics). *Classical and Quantum Gravity;* 3: No. 5, 763-771(1 Sep 1986). Contract W-7405-ENG-48;AC03-76SF00098.

It is shown that in addition to the d = 5, N = 2 Maxwell-Einstein supergravity theories (MESGT) associated with Jordan algebras there is one other class with a symmetric target space which yields the non-compact CPsup(n) models upon dimensional reduction to four dimensions. It follows that all d = 4 symmetric space MESGT have their origin in d = 5. An investigation is carried out into 'kinky supergravities', i.e those for which the target manifold interpolates between two symmetric spaces. It is pointed out that d = 5, N = 2 MESGT are related to d = 11 supergravity by compactification on Calabi-Yau spaces.

## 70 FUSION ENERGY

*REFER ALSO TO CITATION(S) 7798, 7799*

8181 **(CONF-871186—1) Description of evaluation of / sup nat/Pb performed for ENDF/B-VI.** Larson, D.C.; Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002531/JAW.

From Meeting on the international nuclear data library for fusion reactor technology; Vienna, Austria (16 Nov 1987).

An evaluation of data for neutron induced reactions on natural lead was performed for ENDF/B-VI and is briefly reviewed. The evaluation is based on experimental data and results of model calculations which reproduce the experimental data. Evaluated data are given for neutron induced reaction cross sections, angular and energy distributions, and for gamma-ray production cross sections associated with the reactions. File 6 formats are used to represent energy-angle correlated data. Uncertainty files are included for the major cross sections. Much of the present evaluation is taken over from ENDF/B-IV and ENDF/B-V; emphasis is placed on updates for ENDF/B-VI. 14 refs., 3 figs.

8182 **(CONF-871186—2) Description of evaluation for / sup 50,52,53,54/Cr performed for ENDF/B-VI.** Larson, D.C.; Hetrick, D.M.; Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002530/JAW.

From Meeting on the international nuclear data library for fusion reactor technology; Vienna, Austria (16 Nov 1987).

Isotopic evaluations for /sup 50,52,53,54/Cr performed for ENDF/B-VI are briefly reviewed. The evaluations are based on analysis of experimental data and results of model calculations which reproduce the experimental data. Evaluated data are given for neutron induced reaction cross sections, angular and energy distributions, and for gamma-ray production cross sections associated with the reactions. File 6 formats are used to represent energy-angle correlated data and recoil spectra. Uncertainty files are included for the major cross sections. Detailed evaluations are given for /sup 52,53/Cr, and results of calculations for reactions with large cross sections are used for evaluation of the minor isotopes. 27 refs., 6 figs.

8183 (GA-A—18763, pp 2, Paper 1) **Overview of DOE/OFE diagnostics R & D Program.** Priester, D. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

The diagnostics research and development program is guided primarily by the Office of Fusion Energy (OFE) within the Department of Energy. The OFE is divided into 3 divisions: Division of Development and Technology, Division of Confinement Systems, and Division of Applied Plasma Physics. The Experimental Plasma Research Branch of the Division of Applied Plasma Physics has primary responsibility for the diagnostics R & D.

8184 (GA-A—18763, pp 11, Paper 2) **Pre-workshop view of diagnostic materials program.** Priester, D.; Baur, J. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

At present there is no program to reduce or eliminate damage to diagnostic systems placed in hostile environments. Such systems are needed in the Compact Ignition Tokamak (CIT) and other neutron producing machines. Existing components are susceptible to radiation damage and noise. It is necessary to understand what radiation hardening techniques are available and appropriate.

8185 (GA-A—18763, pp 3, Paper 10) **Reopening remarks and review.** Young, K.M. (Princeton Univ., NJ). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Following extensive review, it is clear that there is a need for a data base with emphasis on radiation hardening. A test facility where hardening data can be acquired is necessary for future fusion devices. To obtain information of interest, more 14 MeV neutron sources are required. Where possible other radiation sources should be utilized. Possibly the most pressing issue is rf windows: prompt serious studies must be made of the effects of 14 MeV, $\gamma$, and fission fluxes. Clearly, cooperation among fusion researchers is needed to address all the current diagnostic system problems.

8186 (GA-A—18763, pp 20, Paper 13) **Fusion materials irradiations fusion MOTA and omega west experiments.** Puigh, R.J. (Westinghouse Hanford Co.). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Two fusion materials irradiations of particular interest are the Fusion Material Open Test Assembly (MOTA) and the Omega West Experiments. The fusion MOTA is scheduled to begin irradiation in the Fast Flux Test Facility beginning in January, 1989. Experiment design has not been completed. The Omega West Reactor at Los Alamos National Laboratory will be used for in-core reactor furnace experiments.

8187 (GA-A—18763, pp 28, Paper 14) **Testing facilities.** Heikkinen, D.W. (Lawrence Livermore National Lab., CA). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Testing facilities for determination of neutron induced radiation damage in plasma diagnostic systems are necessary for contin-

ued advancement of fusion energy devices. The test facilities must be capable of producing fusion-like neutrons. Important characteristics of these sources include neutron flux, neutron energy spectra available sample volume and temperature, presence of other radiations, COST, and DC or pulsed irradiations.

8188 **(GA-A—18763, pp 1, Paper 15) Education plan.** Baur, J. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

There is pressing need for education of fusion people and those in the radiation effects community on the role of radiation hardening in radiation diagnostic. There is no plan at present to do this. The plan is to be proposed and developed. The education methods should include distribution of a primer, the proceedings of this workshop, and updated data compilations and talks by experts at the fusion labs, universities, and meetings.

8189 **(INIS-BR—897) Proceedings of the Energy Independence Conference: Fusion Energy and Plasma Physics.** (Sociedade Brasileira de Fisica, Rio de Janeiro). 1987. 135p. (CONF-870836—). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW.

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

It is presented papers on laser fusion, tokamaks experiments, magnetic confinement and plasma physics. (E.G.).

## 7001 Plasma Research

*REFER ALSO TO CITATION(S) 7445, 7960, 7961, 7962, 7963, 7964, 7965, 7966, 7967, 8314, 8315, 8330, 8335, 8346, 8351, 8352*

8190 **(CONF-871007—52) Ignition in near term D-$^3$He tokamak reactors: Appendix B.** Emmert, G.A.; Deng, B.Q. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 1987. Contract FG02-87ER52140. 3p. NTIS, PC A02. Order Number DE88002463/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The prospects for achieving breakeven and ignition in near term ETR type tokamaks under D/He-3 relevant conditions are considered. Using present scaling laws for beta in the first stability regime, it is found that CIT may be close to breakeven with the presently planned toroidal magnetic field system, if the ASDEX H-mode scaling law is used. With Kaye-Goldston scaling, Q = .22 can be attained, but this requires an excessive amount of rf heating power. Larger devices, such as NET/INTOR, can ignite with ASDEX H-mode scaling with an increase of the toroidal field by 20% and removal of the blanket and reduction of the inboard shield to that required for D/He-3. 5 refs., 4 figs., 2 tabs.

8191 **(DOE/ER/52090—3) [Wave launcher heating studies in the ion cyclotron frequency range: Final report].** (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). 1986. Contract AC02-83ER52090. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001866/JAW.

This progress report discusses our work on the analysis, design, fabrication and laboratory measurements on an ion cyclotron frequency range (ICRF) waveguide launcher. We have developed a computer code to solve for the surface impedance for a fast ICRF wave emanating from a dielectric filled guide in the presence of a general plasma density profile. We have formulated a scattering matrix formalism and developed a computer code to determine the coax probe size and distance to a sliding short to match the incident coax wave to the outgoing plasma ICRF wave emanating from the guide for general plasma impedances. We have also made measurements on a fabricated waveguide launcher for the cases of both air and de-ionized, distilled water-filled guides. We have begun to consider the case of an ion Bernstein wave launcher and a vacuum-filled ridged waveguide launcher. 8 figs., 4 tabs.

8192 **(DOE/ER/53216—T2) [Wisconsin Torsatron/Stellarator Program: FY 1988].** (Wisconsin Univ., Madison (USA). Dept. of Electrical and Computer Engineering). 1987. Contract FG02-86ER53216. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002515/JAW.

The Torsatron/Stellarator Laboratory Program during the present period has concentrated on experimental investigations into ECR-produced plasmas in the IMS device. Significant progress has been made in understanding the role of convection in maintaining the hollow plasma density profiles under a wide range of operating conditions. Diverior studies have continued to show good agreement with predictions derived from simple field-line models and the ability to effect particle flows through biasing of divertor plates. Preliminary fluctuation studies showed a dependence of the amplitudes of the fluctuations and profile shapes as a function of the magnetic topology of the device. Theoretical support of the experimental program has provided models to help interpret the experimental results. New initiatives have begun in reduced-Q operation of the Proto-Cleo Stellarator, and in ion-Bernstein wave heating in IMS.

8193 **(DOE/ER/53227—114) Alfven wave studies on a tokamak.** Kortbawi, D. (Wisconsin Univ., Madison (USA). Plasma Physics Research). Oct 1987. Contract FG02-86ER53227. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88002183/JAW.

The continuum modes of the shear Alfven resonance are studied on the Tokapole II device, a small tokamak operated in a four node poloidal divertor configuration. A variety of antenna designs and the efficiency with which they deliver energy to the resonant layer are discussed. The spatial structure of the driven waves is studied by means of magnetic probes inserted into the current channel. In an attempt to optimize the coupling of energy in to the resonant layer, the angle of antenna currents with respect to the equilibrium field, antenna size, and plasma-to-antenna distance are varied. The usefulness of Faraday shields, particle shields, and local limiters are investigated. Antennas should be well shielded, either a dense Faraday shield or particle shield being satisfactory. The antenna should be large and very near to the plasma. The wave magnetic fields measured show a spatial resonance, the position of which varies with the value of the equilibrium field and mass density. They are polarized perpendicular to the equilibrium field. A wave propagates radially in to the resonant surface where it is converted to the shear Alfven wave. The signal has a short risetime and does not propagate far toroidally. These points are all consistent with a strongly damped shear Alfven wave. Comparisons of this work to theoretical predictions and results from other tokamaks are made.

8194 **(DOE/ET/51013—232) Electron velocity-space diffusion in a micro-unstable ECRH [electron cyclotron resonance heated] mirror plasma.** Hokin, S.A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Sep 1987. Contract AC02-78ET51013. 152p. (PFC/RR—87-17). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88002593/JAW.

An experimental study of the velocity-space diffusion of electrons in an electron cyclotron resonance heated (ECRH) mirror plasma, in the presence of micro-unstable whistler rf emission, is presented. It is found that the dominant loss mechanism for hot electrons is endloss produced by rf diffusion into the mirror loss cone. In a standard case with 4.5 kW of ECRH power, this loss limits the stored energy to 120 J with an energy confinement time of 40 ms. The energy confinement time associated with collisional scattering is 350 ms in this case. Whistler microinstability rf produces up to 25% of the rf-induced loss. The hot electron temperature is not limited by loss of adiabaticity, but by rf-induced loss of high energy electrons, and decreases with increasing rf power in strong diffusion regimes. Collisional loss is in agreement with standard scattering theory. No super-adiabatic effects are clearly seen. Experiments in which the vacuum chamber walls are lined with microwave absorber reveal that single pass absorption is limited to less than 60%, whereas experiments with reflecting walls exhibit up to 90% absorption. Stronger diffusion is seen in the latter, with a hot electron heating rate which is twice that of the absorber experi-

ments. This increase in diffusion can be produced by two distinct aspects of wall-reflected rf: the broader spatial rf profile, which enlarges the resonant region in velocity space, or a reduction in super-adiabatic effects due to randomization of the electron gyrophase. Since no other aspects of super-adiabaticity are observed, the first mechanism appears more likely. 39 refs., 54 figs.

8195 **(ENEA-RT-FUS—87-8) Data about coronal equilibrium including the autoionization processes.** Mazzitelli, G.; Walder, V.S. (ENEA, Frascati, Italy. Centro Ricerche Energia; Sao Paulo Univ., Brazil. Inst. de Fisica). (ENEA, Rome (Italy)). 1987. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700792/JAW.

Ionization rate coefficients are calculated with the semiemperical formula proposed by Burgess and Chidichimo and are compared with the Lotz's formula. Coronal equilibrium are also deduced. Curves are presented for C, O, Al, Ar, Cr, Mn, Fe, Ni.

8196 **(EUR—11113-EN) JET Joint Undertaking. Progress report 1986.** Keen, B.E. (ed.). (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). Mar 1987. 595p. (EUR-JET-PR—4). NTIS (US Sales Only), PC A25/MF A01. Order Number DE88751467/JAW.

The paper presents the progress report of the Joint European Torus (JET) Joint Undertaking, 1986. The report contains a survey of the scientific and technical achievements on JET during 1986; the more important articles referred to in this survey are reproduced as appendices to this Report. The last section discusses developments which might improve the overall performance of the machine. (U.K.).

8197 **(EUR—11114-EN) JET Joint Undertaking. Annual report 1986.** Keen, B.E.; Lallia, P.; O'Hara, G.W.; Pollard, I.E. (eds.). (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). Jun 1987. 57p. (EUR-JET-AR—9). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751468/JAW.

The paper presents the annual report of the Joint European Torus (JET) Joint Undertaking, 1986. The report is divided into two parts: a part on the scientific and technical programme of the project, and a part setting out the administration and organisation of the Project. The first part includes: a summary of the main features of the JET apparatus, the JET experimental programme, the position of the Project in the overall Euratom programme, and how JET relates to other large fusion devices throughout the world. In addition, the technical status of JET is described, as well as the results of the JET operations in 1986. The final section of the first part outlines the proposed future programme of JET. (U.K.).

8198 **(EUR-CEA-FC-RA—1986) Annual report 1986.** (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). May 1987. 58p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751389/JAW.

This report gives the 1986 research activity balance of the Department of Research on Controlled fusion and of the Research Group of the Euratom-CEA association. At the end of the year, the whole department and the whole group is working on the new program principally centered on Tore Supra. The last results on TFR and Petula are also described.

8199 (GA-A—18763, pp 22, Paper 3) **CIT machine and diagnostics.** Young, K.M. (Princeton Univ., NJ). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

The purpose of the Compact Ignition Tokamak (CIT) is to study alpha particle heating. All of the diagnostic systems must be able to operate through all phases of operation of the CIT. The feasibility of various diagnostic techniques are to be examined with regard to capability, accessibility, sensitivity, and mechanical design. A program of R & D activities is to be developed.

8200 (GA-A—18763, pp 12, Paper 5) **Baseline data and data sources for fusion diagnostics.** Baur, J.; Wojtowicz, S. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

To appropriately deal with the effects of radiation on fusion diagnostic systems, data is required. Data bases on the topic exist at Kaman-Tempo, the Jet Propulsion Laboratory, and the Marshall Space Flight Center. Areas where data is inadequate include bolometers, windows, fiber optics, and channel plates. It would be desirable to assemble a modestly sized fusion diagnostics data base that is available on the Magnetic Fusion Energy (MFE) network.

8201 **(GTFR—75) Using crossed-sightline correlation of electron cyclotron emission to measure magnetic fluctuations in plasmas.** Thomas, C.E. Jr. (Georgia Inst. of Tech., Atlanta (USA). Fusion Research Center). Sep 1987. Contract FG05-87ER51112. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003504/JAW.

The cause of anomalous loss of energy in tokamak devices has been the subject of an immense amount of research. Microscopic turbulent fluctuations in the plasma are a prime suspect as a source of the anomalous transport. One of the principal candidates as a source of the transport enhancing microturbulence is microfluctuation of the magnetic field. Local measurement of the fluctuating magnetic field has been possible only for very low temperature plasmas where the physical probes used would not be destroyed. Actual local measurements of the magnetic fluctuation frequency spectra and amplitude would be very useful. It may be possible to make this measurement by using techniques adapted from electron cyclotron emission (ECE) and crossed-beam correlation measurements of density fluctuations. The proposed technique consists of correlating the ECE signal from two crossed sightlines through the plasma. The correlated signal is non-zero only for the volume where the two sightlines cross. Thus the frequency of the correlated signal is characteristic of the cyclotron frequency at the crossing point of the two sightlines. If magnetic fluctuations are present, then the frequency will change linearly with the change in the magnetic field at the crossing point. The time variation of the change in frequency of the cross-correlated ECE signals gives a direct measurement of the fluctuation amplitude and frequency of the magnetic field at the crossing point of the two sightlines. 39 refs., 2 figs.

8202 (INIS-BR—897, pp 81) **Electron beam measurements in a linear discharge.** Choi, P.; Chuaqui, H.; Favre, M.; Wyndham, E.S.; Arroyo, L. (Imperial College, London, England; Pontificia Universidad Catolica, Santiago, Chile). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8203 (INIS-BR—897, pp 24) **Tokamak experiments.** Robinson, D.C. (2418200GB). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8204 (INIS-BR—897, pp 26) **TBR (Brazilian Tokamak) - a review of results.** Fagundes, A.N. (Sao Paulo Univ., Brazil). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8205 (INIS-BR—897, pp 51) **Current status of plasma physics research in Latin America.** Chuaqui, H. (Pontificia Universidad Catolica, Santiago, Chile. Faculdad de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8206 (INIS-BR—897, pp 114) **Non equilibrium plasmochemical processes and systems.** Castro B, J. (Santander Univ. Nacional, Colombia. Lab. de Plasma e Fisica de Laser). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8207 (INIS-BR—897, pp 29) **On the effect of a floating limiter in a toroidal plasma discharge.** Venkataramani, N.; Mattoo, S.K. (Institute for Plasma Research, Gandhinagar, India). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8208 (INIS-BR—897, pp 30) **Way to reduce plasma spin-up in field-reversed configurations.** Clemente, R.A. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina. Div. de Fusion Nuclear). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8209 (INIS-BR—897, pp 32) **Plasma magnetic confinement in reversed field pinches.** Ortolani, S. (Consiglio Nazionale delle Ricerche, Italy. Ist. di Gas Ionizzati). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8210 (INIS-BR—897, pp 35) **Plasma heating by microwave in the linear mirror machine LISA.** Rapozo, C.daC.; Assis, A.S. de; Silva, J.C.X. da. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8211 (INIS-BR—897, pp 36) **Lower hybrid and geometrical resonance in linear LISA Machine.** Rapozo, C. da; Silva, H.R.T.; Sakanaka, P.H. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica; Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8212 (INIS-BR—897, pp 39) **Plasma production and expansion by laser irradiation of thin solid foils.** Sudano, J.P.; Goes, L.C.S.; Rodrigues, N.A.S. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. Tecnologico de Aeronautica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8213 (INIS-BR—897, pp 40) **Plasma production and heating by a laser TEA-CO/sub 2/.** Goes, L.C.S.; Sudano, J.P.; Rodrigues, N.A.S. (Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. Tecnologico de Aeronautica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8214 (INIS-BR—897, pp 62) **Gyrotron development at the Instituto de Pesquisas Espaciais.** Barroso, J.J.; Castro, P.J. de; Correa, R.A.; Galvao, G.P. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil. Lab. Associado de Plasmas). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8216 (INIS-BR—897, pp 77) **Ponderomotive and linear fluid responses in a magnetized fusion plasma.** Skoric, M.M.; Kono, M. (Institute of Nuclear Sciences, Belgrade, Yugolavia; Kyushy Univ., Japan. Research Institute for Applied Mechanics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8219 (INIS-BR—897, pp 97) **Transport scaling in field reversed configurations.** Krall, N.A. (JAYCOR, San Diego, CA, USA). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8230 (INIS-BR—897, pp 34) **Dielectric permeability of an inhomogeneous cylindrical plasma.** Amein, W.H. (Nuclear Research Centre, Inshas, Egypt). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8234 (INIS-BR—897, pp 31) **Parabolomak: an analytic spheromak type MHD equilibrium configuration.** Throumoulopoulos, G.N.; Pantis, G. (Ioannina Univ., Greece. Dept. of Physics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8235 (INIS-BR—897, pp 45) **Resonant helical fields in TBR.** Caldas, I.L.; Bender, O.W.; Fernandes, A.S.; Heller, M.V.; Kucinski, M.Y.; Nascimento, I.C. do; Vannucci, A.; Tan, I.H. (Sao Paulo Univ., Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8236 (INIS-BR—897, pp 47) **Design, construction, and operation of a small RPF for turbulent plasma studies.** Aso, Y.; Galvao, R.M.O.; Ueda, M. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil. Lab. Associado de Plasmas). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8237 (INIS-BR—897, pp 54) **Magnetohydrodynamic stability of tokamak plasmas with poloidal mode coupling.** Shigueoka, H.; Sakanaka, P.H. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica; Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8238 (INIS-BR—897, pp 56) **Comparison between the boudary layer and global resistivity methods for tearing modes in reversed field configurations.** Santiago, M.A.M.; Gomes, A.S.; Ponciano, B.M.B. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8244 (INIS-BR—897, pp 106) **Contribution to the study of parametric instabilities in lower hybrid wave experiments in Tokamaks.** Serra, F.M.; Manso, M.E.; Mendonca, J.T. (Instituto Superior Tecnico, Lisbon, Portugal. Centro de Eletrodinamica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8246 (INIS-BR—897, pp 33) **Perpendicular and oblique absorption of electron cyclotron radiation by non-Maxwellian plasmas.** Ziebell, L.F. (Rio Grande do Sul Univ., Porto Alegre, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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8253 (INIS-BR—897, pp 76) **Fast wave and kinetic alfven wave current drive.** Assis, A.S. de; Tsui, K.H.; Busnardo Neto, J. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica; Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

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From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8260 (INIS-BR—897, pp 90) **Theory of the coherent fundamental plasma emission in Tokamaks.** Chian, A.C.-L.; Alves, M.V. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8261 (INIS-BR—897, pp 91) **Modulaton instability of circularly polarized electromagnetic waves near the marginal state of an electron-ion-position plasma.** Rizzato, F.B.; Schneider, R.S.; Dillenburg, D. (Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8262 (INIS-BR—897, pp 92) **Solitons in strongly magnetized electron-position plasmas.** Mofiz, U.A. (Atomic Energy Research Establishment, Dhaka, Bangladesh). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8263 (INIS-BR—897, pp 96) **Wave dynamics of theta pinch implosions.** Tsui, K.H. (Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8264 (INIS-BR—897, pp 99) **MHD mode structure studied by weak helical fields.** Huo, Y.-P. (Academia Sinica, Hefei, Anhui, China. Inst. of Plasma Physics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8265 (INIS-BR—897, pp 110) **Nonlinear interaction of p-polarized at a narrow inhomogeneous layer of the magnetoactive plasma.** Hussein, A.M. (United Arab Emirates Univ. Dept. of Physics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8266 (INIS-BR—897, pp 115) **Access to second stability regime in tokamaks by RF methods.** Sen, A.; Kaw, P.K.; Sundaram, A.K. (Institute for Plasma Research, Gandhinagar, India). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8267 (INIS-BR—897, pp 65) **Plasma technology: a technical, economical and political challenge.** Abreu, V.A. de; Campanario Junior, O.S.; Vicente, L.C. (Instituto de Pesquisas Tecnologicas, Sao Paulo, Brazil). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8268 (INIS-BR—897, pp 72) **Fusion research and third world countries.** El Nadi, A.M. (Cairo Univ., Egypt). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8269 (INIS-BR—897, pp 69) **Portuguese program for research and development in nuclear controlled fusion.** Mendonca, J.T.; Oliveira, J.M.C.; Varandas, C.A.F.; Oliveira, J.M.G.; Teixeira, M.R. (Instituto Superior Tecnico , Lisbon, Portugal. Centro de Electrodinamica; Instituto de Ciencias e Engenharia Nucleares, Sacaven, Portugal. Lab. Nacional de Engenharia e Tecnologia Industrial). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8270 (INIS-BR—897, pp 93) **Sharing of fusion related technology among third world countries.** Lee, S. (Malaya Univ., Malaysia. Dept. of Physics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8271 (INIS-BR—897, pp 95) **Japanese Fusion Research.** Uchida, T. (Nagoya Univ., Japan. Inst. of Plasma Physics). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8272 (INIS-mf—10762) **Joint development effort Thermonuclear Fusion. Programme budgeting 1984.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). [1985]. 42p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751286/JAW.

The joint KfK and IPP project for the development of thermonuclear fusion device is established as the centerpiece of Federal German efforts in this field. It is meant to enhance the German contribution to the European programme and thus foster the chances of a joint European large-scale experiment to be started in the Federal Republic of Germany. IPP's tasks in the project are to study the physical principles and aspects, whereas KfK is responsible for the technological aspects. Work at IPP is focused on divertor experiments with the ASDEX series in order to go deeper into the problems that could not be solved by the JET experiments, namely those of the plasma boundary and control of impurities. Stellarator experiments are made in order to study the potentials of this toroidal confinement concept for steady-state operation. The IPP which always has been working in the plasma physics field devotes all activities to the joint effort. KfK has established a special project group for this purpose, PKF. The budgeting programme presented therefore covers the IPP entire working schedule, and that of PKF of the KfK.

8273 (JAERI-M—87-110) **Effect of discrete RF spectrum on fast wave current drive. Conceptual design study of FY86 FER.** Okazaki, Takashi; Yoshioka, Ken; Sugihara, Masayoshi and others. (Hitachi Ltd., Tokyo, Japan). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751439/JAW.

Effect of discrete RF spectrum has been studied for the fast wave current drive with the ion cyclotron range of frequency. Driven current and power densities decrease in this spectrum than in the continuous spectrum. However, there is a possibility to have the mechanism which allows electrons outside the resonance region to interact with the fast wave, taking into account the electron trapping by discrete RF spectrum. In the case of neglecting the electron trapping effect, driven current and power densities decrease up to 0.6 - 0.8 of those which are obtained for the continuous spectrum for the FER (Fusion Experimental Reactor). However, their driven current and power densities can be almost doubled in their magnitude for the discrete spectrum by taking into account the trapping effect.

8274 (JAERI-M—87-130) **Computation of tokamak equilibria with steady flow.** Kerner, W.; Tokuda, Shinji. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751450/JAW.

The equations for ideal MHD equilibria with stationary flow are reexamined and addressed as numerically applied to tokamak configurations with a free plasma boundary. Both the isothermal (purely toroidal flow) and the poloidal flow cases are treated. Experiment-relevant states with steady flow (so far only in the toroidal direction) are computed by the modified SELENE40 code.

8275 (N—87-29432, pp vp) **Welding arc and plasma studies using real time, multipass holographic interferometry.** Deason, V. May 1987. NTIS, PC A99/MF A01. (NASA-CP—2477; A—87135; NAS—1.55:2477; CONF-8501115—).

From Automated reduction of data from images and holograms; Moffett Field, CA, USA (10 Jan 1985).

Flow visualization of the plasma process in a welding arc is being studied with a multipass Argon ion interferometer. High speed movies at 10,000 frames per/sec are taken. The multipass interferometer and several interferograms of the plasma near the electrode of the welding are given. Digitization of the fringes is currently done by hand.

8276 (PPPL—2428) **Observation of ICRF [ion cyclotron range of frequencies] wave-packet propagation in a tokamak plasma.** Greene, G.J.; Gould, R.W. (Princeton Univ., NJ (USA). Plasma Physics Lab.; California Inst. of Tech., Pasadena (USA)). Nov 1987. Contract AC02-76CH03073. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003472/JAW.

Experimental observation of ICRF wave-packet propagation in a tokamak plasma is reported. Studies were carried out in the Caltech Research Tokamak in a pure hydrogen plasma and in a regime where fast-wave damping was sufficiently small to permit multiple toroidal transits of the wave-packet. Waves were launched by exciting a small loop antenna with a short burst of rf current and were detected with shielded magnetic probes. Probe scans revealed a large increase in wave-packet amplitude at smaller minor radii, and the packet velocity was found to be independent of radial position. Measurement of the packet transit time yielded direct information about the wave group velocity. Packet velocity was investigated as a function of the fundamental excitation frequency, plasma density, and toroidal magnetic field. Results are compared with the predictions of a cold plasma model which includes a vacuum layer at the edge. 24 refs., 8 figs.

8277 (PPPL—2458) **The generalized Balescu-Lenard collision operator: A unifying concept for tokamak transport.** Mynick, H.E. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Aug 1987. Contract AC02-76CH03073. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003471/JAW.

The generalization of the Balescu-Lenard collision operator to its fully electromagnetic counterpart in Kaufman's action-angle formalism is derived and its properties investigated. The general form may be specialized to any particular geometry where the unperturbed particle motion is integrable, and thus includes cylindrical plasmas, inhomogeneous slabs with nonuniform magnetic fields, tokamaks, and the particularly simple geometry of the standard operator as special cases. The general form points to the commonality between axisymmetric, turbulent, and ripple transport, and implies properties (e.g., intrinsic ambipolarity) which should be shared by them, under appropriate conditions. Along with a turbulent "anomalous diffusion coefficient" calculated for tokamaks in previous work, an "anomalous pinch" term of closely related structure and scaling is also implied by the generalized operator. 20 refs. (LSP)

8278 (PPPL—2473) **Magnetic fluctuations can contribute to plasma transport, "self-consistency constraints" notwithstanding.** Krommes, J.A.; Kim, Chang-Bae. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Sep 1987. Contract AC02-76CH03073. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003458/JAW.

The recent conclusion that in a turbulent, collisionless plasma "magnetic transport including quasilinear magnetic flutter transport ... does not contribute to the relaxation of (f), and thus is not responsible for electron energy or momentum transport" is shown to be incorrect for a variety of situations of physical interest, including saturation by quasilinear plateau formation, induced scattering, and, most importantly, conventional mode coupling. The well-established theory of the mean infinitesimal response function and the spectral balance equation provides a unifying framework for understanding the above conclusion. In particular, the cancellations which lead to their conclusion are special cases of well-known relationships between the response function, particle propagator, and dielectric function. A more general, concise, and manifestly gauge-invariant algebraic derivation of the cancellations is given. Though the cancellations occur in a certain limit, these conclusions do not follow in general: The picture of steady-state turbulence as consisting of small-scale "incoherent" ballistic "clumps" shielded by long-wavelength "coherent" dielectric response is physically misleading and mathematically incomplete, as it ignores or mistreates the often dominant process of renormalized n-wave coupling. Thus, when ion nonlinearities are considered, formulas for the magnetic contribution to transport emerge which are quite similar to the qua-

silinear one. Furthermore, limits are possible in which all or part of the noise can be negligible, yet in which the total fluctuation spectrum remains finite. 56 refs.

8279 **(PPPL—2478) Electron diamagnetism and toroidal coupling of tearing modes.** Cowley, S.C.; Hastie, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.; UKAEA Culham Lab., Abingdon). Oct 1987. Contract AC02-76CH03073. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003452/JAW.

Using a simple model for the layer of the tearing mode, we demonstrate that toroidally coupled tearing modes with two rational surfaces are most unstable when the $\omega^*$'s of the electrons at the rational surfaces are equal. The onset of instability may then occur because of the tuning of $\omega^*$ rather than the passage of $\Delta'$-like quantities through zero. This mechanism for the onset of instability is sharp since the resonance is narrow. The effect of toroidal rotation is also discussed. 7 refs., 2 figs.

8280 **(PPPL—2479) MHD activity and energy loss during beta saturation and collapse at high beta poloidal in PBX.** Kugel, H.W.; Sesnic, S.; Bol, K.; Chance, M.; Fishman, H.; Fonck, R.; Gammel, G.; Kaita, R.; Kaye, S.; LeBlanc, B. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1987. Contract AC02-76CH03073. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003453/JAW.

High-$\beta$ experiments, in medium to high-q tokamak plasmas, exhibit a temporal $\beta$ saturation and collapse. This behavior has been attributed to ballooning, ideal kink, or tearing modes. In PBX, a unique diagnostic capability allowed studies of the relation between MHD and energy loss for neutral-beam-heated (<6 MW), mildly indented (10 to 15%), nearly steady I/sub p/ discharges that approached the Troyon-Gruber limit. Under these conditions, correlations between MHD activity and energy losses have shown that the latter can be almost fully accounted for by various long wavelength MHD instabilities and that there is no need to invoke high-n ballooning modes in PBX. 6 refs., 4 figs.

8281 **(PPPL—2481) Progress in toroidal confinement and fusion research.** Furth, H.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1987. Contract AC02-76CH03073. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003455/JAW.

During the past 30 years, the characteristic T/sub i/n tau/sub E/-value of toroidal-confinement experiments has advanced by more than seven orders of magnitude. Part of this advance has been due to an increase of gross machine parameters. Most of this advance has been due to an increase of gross machine parameters. Most of the advance is associated with improvements in the "quality of plasma confinement." The combined evidence of spherator and tokamak research clarifies the role of magnetic-field geometry in determining confinement and points to the importance of shielding out plasma edge effects. A true physical understanding of anomalous transport remains to be achieved. 39 refs., 11 figs., 1 tab.

8282 **(PPPL—2482) MHD analysis of high ($\beta$/sub t/) disruptions in PBX [Princeton Beta Experiment].** Jahns, G.L.; Chance, M.S.; Kaye, S.M.; Manickam, J.; Takahashi, H.; LeBlanc, B.; Morris, A.W.; Reusch, M.; Sesnic, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1987. Contract AC02-76CH03073. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003456/JAW.

PBX discharges run at the lowest q and highest ($\beta$/sub t/) always terminated in a hard disruption. The discharges, with ($\beta$/sub t/) values of up to 5.5% and q-values down to 2.2, were obtained by employing large current ramps and large gas feed rates during neutral beam injection. Previous work has indicated that the achieved ($\beta$/sub t/)-values were consistent with the limit imposed by the n = 1 ideal external kink with a conducting wall at b/a = 2. In this work, we investigate further the validity of ideal MHD theory in explaining the low-q/sub psi/j disruptions. In particular, the character of the pre-disruption MHD activity in these low-q discharges, specifically the time scales of growth and internal and external mode structures, was compared with those determined from theoretical calculations. The results of these comparisons indicate that non-ideal effects must be considered to obtain detailed agreement between theory and experiment. 13 refs., 6 figs.

8283 **(PPPL—2486) Anomalous electron diffusion across a magnetic field in a beam-plasma system.** Okuda, H.; Ono, M.; Armstrong, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.; Tromsoe Univ. (Norway)). Oct 1987. Contract AC02-76CH03073. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003450/JAW.

The diffusion of electrons across a magnetic field in the presence of a beam-plasma instability has been studied by means of two-dimensional numerical simulations. It is found that the beam electrons can diffuse much faster across the magnetic field than the thermal electrons. This can be explained by the fact that the electrons in the beam are in resonance with the waves excited by the beam-plasma instability so that they experience a nearly dc electric field, causing large cE x $B/B^2$ excursions. 8 refs., 5 figs.

8284 **(PPPL—2487) Resistive interchange instability criterion in anisotropic toroidal systems.** Johnson, J.L.; Hastie, R.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.; UKAEA Culham Lab., Abingdon). Nov 1987. Contract AC02-76CH03073. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003451/JAW.

Ideal (Mercier) and resistive criteria for localized magnetohydrodynamic instabilities are derived for general toroidal systems with anisotropic pressure. 7 refs.

8285 **(UCRL—15973) FEM [Free Electron Maser] for tokamak: Final report.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). 1987. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002471/JAW.

This paper studies the feasibility of a microwave source for heating a tokamak reactor. The free electron maser (FEM) shows great promise for being this source. The topics covered in this paper are microwave generation with FEM, efficiency enhancement, parameter scaling, space charge scaling, beam energy spread and efficiency scaling, electron beam line with energy recovery, achromatic bend, multi-stage depressed voltage electron beam collector, and development plans. 12 refs., 10 figs., 5 tabs. (LSP)

8286 **(UCRL—96761) Disruption control in tokamak reactors by electron-cyclotron current drive.** Smith, G.R.; Logan, B.G.; Kritz, A.H.; White, R.B. (Lawrence Livermore National Lab., CA (USA); Hunter Coll., New York (USA). Dept. of Physics and Astronomy; Princeton Univ., NJ (USA). Plasma Physics Lab.). 23 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—57). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002388/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Launch scenarios for electron-cyclotron power into TIBER-II equilibria are presented. The power is absorbed outside the q = 2 flux surface, and the driven current significantly modifies the current profile, which may serve to suppress tearing-mode instabilities and prevent disruptions. A feedback-stabilization scheme may suppress the instabilities with very modest incident power. One of the launch scenarios is also effective for heating the plasma core during the startup phase. 15 refs., 4 figs.

8287 **(UCRL—97359) Particle simulation of intense electron cyclotron heating and beat-wave current drive.** Cohen, B.I. (Lawrence Livermore National Lab., CA (USA)). 12 Oct 1987. Contract W-7405-ENG-48. 7p. (CONF-8709184—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002392/JAW.

From US/Japan workshop on plasma modeling with MHD and particle simulation; Napa, CA, USA (25 Sep 1987).

High-power free-electron lasers make new methods possible for heating plasmas and driving current in toroidal plasmas with electromagnetic waves. We have undertaken particle simulation studies with one and two dimensional, relativistic particle simulation codes of intense pulsed electron cyclotron heating and beat-wave current drive. The particle simulation methods here are conventional: the algorithms are time-centered, second-order-accurate, explicit, leap-frog difference schemes. The use of conventional methods restricts the range of space and time scales to be relatively

compact in the problems addressed. Nevertheless, experimentally relevant simulations have been performed. 10 refs., 2 figs.

8288 **(UCRL—97504) Engineering study of the neutral beam and rf heating systems for DIII-D, MFTF-B, JET, JT-60 and TFTR.** Lindquist, W.B.; Staten, S.H. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—56). NTIS, PC A02. Order Number DE88002450/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

An engineering study was performed on the rf and neutral beam heating systems implemented for DIII-D, MFTF-B, JET, JT-60 and TFTR. Areas covered include: methodology used to implement the systems, technology, cost, schedule, performance, problems encountered and lessons learned. Systems are compared and contrasted in the areas studied. Summary statements were made on common problems and lessons learned. 3 refs., 6 tabs.

8289 **Fractional power operation of tokamak reactors: Issues and prospects.** Mau, T.K.; Vold, E.L.; Conn, R.W. (Univ. of California, Los Angeles, Fusion Engineering and Physics Program, Dept. of Mechanical, Aerospace and Nuclear Engineering, 6291 Boelter Hall, Los Angeles, CA 90024). *Fusion Technology;* **12**: No. 2, 181-197(Sep 1987).

The capability of a power plant to operate at a wide range of output power is essential for initial commissioning and normal maintenance. Critical physics issues related to operating a tokamak fusion reactor at fractions of its rated power are explored, and methods for power control are identified. Analysis is carried out with a steady-state, profile-dependent, zero-dimensional power balance model of the plasma, in which several empirical transport scalings appropriate to tokamaks are used. It is found that reactor operation depends strongly on the confinement model, the plasma beta limit, and the effect of alpha power on transport. Parametric calculations indicate that density, auxiliary heating power, and an effective external confinement control mechanism are the key control elements, and burn control is required in most cases. Transition between power plateaus is facilitated by operating in the hybrid transformer mode. In general, the impact of fractional power operation on full-power reactor designs appears to be small.

8290 **Enhanced Migma and nuclear safety.** Mc Nally, J.R. Jr. *Fusion Technology;* **12**: No. 2, 320-323(Sep 1987).

All prior calculations of the rho/sup 6/Li fusion chain reaction and the rho/sup 11/ reaction prospects indicate that these fuels do not permit ignition against radiation losses, fuel heating requirements, and ash and unburned fuel exhaust losses. This work suggests that such fusion fuels may ignite against such losses and heating requirements in a nuclear dynamo configuration of the ion-layer, electron-core type due to the strong E x B ion drive, which heats the heavy ions preferentially and very rapidly compared to the much lighter electrons. In this work the role of E x B drive in enhancing the Migma experimental series is outlined, and questions of nuclear safety are raised as a result of anticipated large T/sub i// T/sub e/ ratios.

8291 **Tokamak power reactor ignition and time-dependent fractional power operation.** Vold, E.L.; Mau, T.K.; Conn, R.W. (Univ. of California, Los Angeles, Fusion Engineering and Physics Program, Dept. of Mechanical, Aerospace, and Nuclear Engineering, 6291 Boelter Hall, Los Angeles, CA 90024). *Fusion Technology;* **12**: No. 2, 197-229(Sep 1987).

A flexible time-dependent, zero-dimensional plasma burn code with radial profiles was developed and employed to study the fractional power operation and the thermal burn control options for an International Tokamak Reactor (INTOR) sized tokamak reactor. The code includes alpha thermalization and a time-dependent transport loss that can be represented by any one of several currently popular scaling laws for energy confinement time. Feedback control of the auxiliary power and ion fuel sources are shown to provide thermal stability for operating points near the low-density, high-temperature portion of the ignition curve. It is concluded that the problem of thermal control and fractional power operation of a tokamak reactor with ignited plasma is far from trivial.

8292 **Comparative measurement of the neutral density and particle confinement time in EBT-S.** Glowienka, J.C.; Richards, R.K. (Oak Ridge National Lab., TN, USA). *Journal of Plasma Physics;* **35**: 519-528(Jun 1986).

The neutral density and particle confinement time in the ELMO Bumpy Torus-Scale Experiment (EBT-S) have been determined by two different techniques. These involve a spectroscopic measurement of molecular and atomic hydrogen emissions and a time-decay measurement of a fast-ion population using a diagnostic neutral beam. The results from both diagnostics exhibit identical trends for either estimate, although the absolute values differ by a factor of 2 to 3. The observed variations with fill gas pressure and microwave power from either technique are consistent with measurements of electron density and temperature. The measurement techniques are discussed, and the results are compared in the context of consistency with independently observed plasma behaviour.

8293 **Langmuir nucleation and collapse in stimulated laser light scatter.** Aldrich, C.H.; Bezzerides, B.; Dubois, D.F.; Rose, H.A. (Los Alamos National Lab., NM, USA). *Comments on Plasma Physics and Controlled Fusion;* **10**: No. 1, 1-18(May 1986).

Recent experiments appear to demonstrate an interaction between stimulated Raman scattering (SRS) and stimulated Brillouin scattering (SBS). The effect of pre-existing or coexisting density modulations on SRS is discussed. It is suggested that these density waves can effect the evolution of SRS and trigger the Langmuir collapse of the excited plasma waves profoundly influencing the backscattered light and the hot electron generation. The simultaneous excitation of SBS is proposed as a possible source for the ion waves, and a condition for collapse is obtained.

8294 **Large-scale disruptions in a current-carrying magnetofluid.** Dahlburg, J.P.; Montgomery, D.; Doolen, G.P.; Matthaeus, W.H. (College of William and Mary, Williamsburg, VA, USA. Dept. of Physics; Dartmouth Coll., Hanover, NH, USA. Dept. of Physics and Astronomy; Los Alamos National Lab., NM, USA; Delaware Univ., Newark, USA. Bartol Research Foundation). *Journal of Plasma Physics;* **35**: No. pt.1, 1-42(Feb 1986).

A pseudo-spectral three-dimensional Strauss-equations code is used to describe internal disruptions in a strongly magnetized, electrically-conducting fluid, with and without an externally applied, axial electric field.

8295 **Lower-hybrid instabilities driven by an ion velocity ring.** Akimoto, K.; Papadopoulos, K.; Winske, D. (Maryland Univ., College Park, USA. Dept. of Physics and Astronomy; Los Alamos National Lab., NM, USA). *Journal of Plasma Physics;* **34**: 445-465(Dec 1985).

The lower-hybrid instabilities in high-beta plasmas driven by ring-ion distributions in velocity space are investigated. A dispersion equation including electromagnetic effects is derived. In the low-beta limit, analytic expressions are obtained which illuminate the physical nature of the instabilities. The complete dispersion equation is solved numerically as a function of ring speed and plasma beta for several types of ring distribution. Electromagnetic effects are important for relatively energetic rings even in the low-beta regime, suppressing growth rates and shifting the angle of propagation to more oblique angles. Stabilization by thermal effects is also discussed. Application of these results to the Earth's bow shock, AMPTE, comets and solar flares is suggested.

8296 **Ion-acoustic instabilities driven by an ion velocity ring.** Akimoto, K.; Papadopoulos, K.; Winske, D. (Maryland Univ., College Park, USA. Dept. of Physics and Astronomy; Los Alamos National Lab., NM, USA). *Journal of Plasma Physics;* **34**: 467-479(Dec 1985).

A ring distribution of ions in velocity space can generate electrostatic waves which propagate predominantly along an ambient magnetic field at frequencies comparable with the ion plasma frequency. A dispersion equation which accounts for these waves is presented, and solved analytically and numerically. It was found that ion-acoustic-like waves are excited if a plasma even in the elec-

tron temperature is comparable with the ion temperature under the assumption of an anistropic ion distribution.

8297 **Iterative solution to the non-LTE line transport problem.** Buchler, J.R.; Auer, L.H. (Physics Dept., Univ. of Florida). pp 58-68 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

In the case of a slab geometry the authors have tested an iteration scheme which gives a fast convergence to the solution. In the spirit of Cannon's approach an approximate lambda operator $\Lambda^*$ is inverted and the difference $(\Lambda-\Lambda^*)S$ is treated as a small correction. The approximate $\Lambda^*$ operator is basically the first order escape probability plus an artificial diffusion term added for numerical stabilization. An extension to the two-dimensional problem is in progress.

8298 **Detailed modeling of ionization/radiation in dense plasmas.** Duston, D. (Naval Research Lab., Washington, DC 20375). pp 107-141 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

As newer, more sophisticated instrumental techniques for plasma diagnostics are rapidly developed, the necessity to keep pace with experiments via novel, more detailed, theoretical plasma models becomes more and more apparent. In addition, ionization and radiation processes have recently been shown to compete with more classical fluid phenomena in determining basic properties for many density and temperature regimes in laboratory plasmas. In this paper a brief description of the modeling techniques used at NRL to describe dense, high-temperature plasma radiation is presented. In a true "workshop" spirit, several problem areas in radiation modeling are discussed, along with several topics of research presently under development. The implementation of these modeling techniques will be demonstrated using a detailed atomic model for Krypton which has recently been completed; this model consists of 140 atomic levels in the K, L, and M shells and includes the emission from more than 500 lines. Discussion of the plasma emission includes both energetic and diagnostic aspects of the radiation.

8299 **Spectrum formation in dense non-LTE plasmas.** Whitney, K.G. (Optical Sciences Div., Naval Research Lab.). pp 142-172 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Many factors can contribute to the shape and intensity of the emitted radiation spectrum from high density and optically thick plasmas. Two of the most important, however, are the non-LTE state of plasma medium and the significant overlap of the individual line and continuum emission and reabsorption processes. In this paper, a new description is presented of the relationship between line, radiative recombination, and bremmstrahlung source functions and the underlying non-LTE state of the medium. The way in which these processes can strongly overlap is then partially illustrated with an example from a detailed calculation of the K-shell emission spectrum in a dense argon plasma.

8300 **Line broadening and ionization lowering in dense argon plasmas.** Davis, J.; Blaha, M.; Gupta, U. (Naval Research Lab., Washington, DC 20375). pp 261-280 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Energy levels are calculated for hydrogenlike argon ions in a dense, hot argon plasma. The line broadening due to the plasma environment and electron impacts are described using the Density Functional Method and Nonlinear Screening Theory. In addition, ionization lowering is evaluated quantum mechanically and compared with the conventional values obtained by employing cutoffs such as the Debye or nearest neighbor distance.

8301 **Asymmetry of stark-broadened lyman lines from laser-produced plasmas.** Woltz, L.A.; Hooper, C.F. Jr. (Physics Dept., Univ. of Florida, Gainesville, FL 32611). pp 476-500 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—).

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Two significant causes of spectral line asymmetry, the quadratic Stark effect and fine structure splitting, are included in the calculation of Lyman line profiles emitted by highly-ionized hydrogenic radiators in a dense, hot plasma. The line asymmetries are shown to be strongly dependent on the plasma density, indicating that the asymmetry may be of use as a density diagnostic.

8302 **Thermal occupation and pressure of resonance states.** More, R.M. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). pp 519-527 of Proceedings of the 2nd international conference on radioactive properties of hot dense matter. Davis, J.; Hooper, C.; Lee, R.; Merts, A.; Rozsnyai, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-8310178—). Contract W-7405-ENG-48.

From 2. international conference and workshop on radiative properties of hot dense matter; Sarasota, FL, USA (31 Oct 1983).

Continuum shape resonance resulting from the pressure-ionization of bound electrons are predicted by several recent self-consistent field calculations of matter in hot dense plasmas. In this paper, rigorous formulas are developed for the thermal occupation and pressure of resonance states.

8303 **Computer modeling of fast collisionless reconnection.** Leboeuf, J.N.; Brunel, F.; Tajima, T.; Sakai, J.; Wu, C.C.; Dawson, J.M. (Institute for Fusion Studies, Univ. of Texas, Austin, TX 78712). pp 282-291 of Magnetic reconnection in space and laboratory plasma. Hones, E.W. Washington, DC; American Geophysical Union (1984). (CONF-8310229—).

From Chapman conference on magnetic reconnection; Los Alamos, NM, USA (3 Oct 1983).

Particle simulations of collisionless tearing, reconnection and coalescence of magnetic fields for a sheet-pinch configuration show that reconnection is Sweet-Parker like in the tearing and island formation phase. It is much faster, or even explosive, in the island coalescence stage. Island coalescence is the most energetic process and leads to large ion temperature increase and oscillations in the merged state. Similar phenomena have been observed in equivalent MHD simulations. Coalescence and its effects, as observed in the authors' simulations, may explain many of the features of solar flares and coronal X-ray brightening.

## 7002 Fusion Power Plant Technology

*REFER ALSO TO CITATION(S) 7445, 7640, 7685, 7694, 7695, 7699, 7705, 7966, 7967, 8272, 8367*

8304 **(CONF-870901—12) Test results of the US-LCT pool-boiling coils in the International Fusion Superconducting Magnet Test Facility (IFSMTF).** Shen, S.S.; Dresner, L.; Lubell, M.S.; Lue, J.W.; Luton, J.N.; McManamy, T.J.; Wilson, C.T.; Wintenberg, R.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE88002604/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The international Large Coil Task (LCT) has designed, built, and successfully tested six different toroidal field coils. Each has a 2.5- x 3.5-m D-shaped bore, a current between 10 and 18 kA, and is designed for stable operation at 8 T, with a superimposed pulsed field of 0.14 T in 1.0 s, and simulated nuclear heating. Included in the torus are two pool-boiling coils designed and fabricated by US firms, General Dynamics/Convair Division (GD) and General Electric/Oak Ridge National Laboratory (GE). Both coils were well instrumented for studies of electromagnetic, mechanical, and thermodynamic properties. Both coils performed well and met design specifications. In later "extended-condition" full-array tests beyond the design values, both operated stably at 100% design current and above 9 T, even with bath temperature higher than 4.3 K. The mechanical behavior of both coils was generally in good agreement with calculations. Both coils were also safely discharged several times in the extended-condition tests. All results indicate that the technology developed for these two pool-boiling LCT coils can be directly applied for future large-scale applications. 5 refs., 5 figs., 9 tabs.

8305 **(CONF-871007—12) A calorimeter for measuring the neutral beam power reaching the plasma.** Menon, M.M.; Edmonds, P.H.; Hahs, C.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. Order Number DE88001412/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A calorimeter has been designed to measure the neutral beam power reaching the Advanced Toroidal Facility (ATF) plasma. The high-heat-flux surface of this calorimeter is made of an array of graphite tiles. The calorimeter, which will be located in the adapter section between the ATF vacuum vessel and the beam line, is retractable so that it can be moved away from the plasma without opening the vacuum vessel during normal ATF operation. Two rows of thermocouples mounted perpendicular to each other allow determination of the beam profile. This paper presents the details of the design and fabrication of the calorimeter. 5 refs., 6 figs.

8306 **(CONF-871007—49) An outboard shield design for TIBER-II with potential for tritium self-sufficiency: Appendix A-1.** Sawan, M.E.; Sviatoslavsky, I.N. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 1987. Contract FG02-87ER52140. 5p. NTIS, PC A02. Order Number DE88002459/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The outboard breeding shield design for TIBER-II is described. The design allows for tritium self-sufficiency without compromising magnet protection, design simplicity, and the testing mission of the device. The shield consists of a beryllium pebble front zone backed by a steel pebble zone. The shield is cooled by an aqueous solution containing 16 g $LiNO_3$ per 100 $cm^3$. A double first wall is used to insure uniform cooling and minimize pressure. The design pressure for the outboard shield is 0.19 MPa and the coolant temperature is less than 75°C. 6 refs., 5 figs., 3 tabs.

8307 **(CONF-871007—50) High performance inboard shield design for the compact TIBER-II test reactor: Appendix A-2.** El-Guebaly, L.A.; Sviatoslavsky, I.N. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 1987. Contract FG02-87ER52140. 5p. NTIS, PC A02. Order Number DE88002460/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The compactness of the TIBER-II reactor has placed a premium on the design of a high performance inboard shield to protect the inner legs of the toroidal field (TF) coils. The available space for shield is constrained to 48 cm and the use of tungsten is mandatory to protect the magnet against the 1.53 $MW/m^2$ neutron wall loading. The primary requirement for the shield is to limit the fast neutron fluence to $10^{19}$ $n/cm^2$. In an optimization study, the performance of various candidate materials for protecting the magnet was examined. The optimum shield consists of a 40 cm thick W layer, followed by an 8 cm thick $H_2O/LiNO_3$ layer. The mechanical design of the shield calls for tungsten blocks within SS stiffened panels. All the coolant channels are vertical with more of them in the front where there is a high heat load. The coolant pressure is 0.2 MPa and the maximum structural surface temperature is <95°C. The effects of the detailed mechanical design of the shield and the assembly gaps between the shield sectors on the damage in the magnet were analyzed and peaking factors of ~2 were found at the hot spots. 2 refs., 6 figs., 2 tabs.

8308 **(CONF-871007—51) Ra: A high efficiency, D-$^3$He, tandem mirror fusion reactor: Appendix C.** Santarius, J.F.; Attaya, H.; Corradini, M.L.; El-Guebaly, L.A.; Emmert, G.A.; Kulcinski, G.L.; Larsen, E.M.; Maynard, C.W.; Musicki, Z.; Sawan, M.E. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 1987. Contract FG02-87ER52140. 5p. NTIS, PC A02. Order Number DE88002464/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Ra tandem mirror fusion reactor concept features inherent safety, high net plant efficiency, low cost of electricity, low radioactive waste generation, low activation, highly efficient direct conversion, thin radiation shields, and axisymmetric magnets. The safety and environmental features are achieved through the use of D/He-3 fuel, while the high efficiency derives from a new operating mode. ICRF stabilization allows an axisymmetric magnet set. 11 refs., 5 figs., 3 tabs.

8309 **(CONF-871007—53) LOFA [loss of flow accident] and LOCA [loss of coolant accident] in the TIBER-II engineering test reactor: Appendix A-4.** Sviatoslavsky, I.N.; Attaya, H.M.; Corradini, M.L.; Lomperski, S. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 1987. Contract FG02-87ER52140. 5p. NTIS, PC A02. Order Number DE88002462/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

This paper describes the preliminary analysis of LOFA (loss of flow accident) and LOCA (loss of coolant accident) in the TIBER-II engineering test reactor breeding shield. TIBER-II is a compact reactor with a major radius of 3 m and thus requires a thin, high efficiency shield on the inboard side. The use of tungsten in the inboard shield implies a rather high rate of afterheat upon plasma shutdown, which must be dissipated in a controlled manner to avoid the possibility of radioactivity release or threatening the investment. Because the shield is cooled with an aqueous solution, LOFA does not pose a problem as long as natural convection can be established. LOCA, however, has more serious consequences, particularly on the inboard side. Circulation of air by natural convection is proposed as a means for dissipating the inboard shield decay heat. The safety and environmental implications of such a scheme are evaluated. It is shown that the inboard shield temperature never exceeds 510°C following LOCA posing no hazard to reactor personnel and not threatening the investment. 7 refs., 6 figs.

8310 **(CONF-871007—54) TIBER activation analysis: Appendix A-3.** Attaya, H. (Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 1987. Contract FG02-87ER52140. 5p. NTIS, PC A02. Order Number DE88002461/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

TIBER-II is an engineering test reactor designed to establish the technical feasibility for fusion, and is a US option for the prospective International Thermonuclear Test Reactor (ITER). The TIBER-II baseline design has 3 m major radius, 3.6 aspect ratio, and 1.1 $MW/m^2$ average neutron wall loading. The inboard shield is about .5 m thick and structurally consists of tungsten alloy and PCA alloy. The outboard is 1.52 m thick and utilizes PCA as structure and beryllium as a neutron multiplier. An aqueous solution of 160 g $LiNO_3$/liter is used throughout as a coolant and breeder. A one-dimensional cylindrical model for TIBER is used to calculate the neutron flux and the radioactivities. Activities are calculated during and after 2.5 full power years (FPY) of operation. TIBER total activity is ~2 MCi/cm at the end of operation and is dominated by the inboard activity. The high volumetric fraction of the PCA/W alloys in the inboard shield, used to provide magnet pro-

tection at the limited inboard space, makes the inboard specific activity two orders of magnitude higher than that of the outboard and dominant all the time. The decay heat due to $\beta$ and $\gamma$ decay produces about .05 W/cc in the inboard at shutdown and for a few weeks. Under adiabatic conditions, this heat would raise the inboard shield temperature up to 1150°C. A considerable part of this heat is generated by the $\gamma$ decay which might help, through the $\gamma$ transport, to smooth the heat concentration. Waste disposal ratings of the TIBER structures have been calculated, and it is found that both the inboard and the outboard shield are classified as Class C radwaste. 4 refs., 4 figs., 3 tabs.

8311 (CONF-871007—71-Vugraphs) **The configuration development of the compact ignition tokamak (CIT) device.** Brown, T.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002619/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The paper consists of viewgraphs discussing different component design options for the Compact Ignition Tokamak (CIT). The author concludes that a CIT device configuration has been established which meets physics requirements, performance margins and engineering component design needs. The baseline ($R_0$ = 1.75 meters) machine appears reasonable based on the analysis performed to date. (LSP)

8312 (DOE/ET/51013—193) **GENLPLOT: An interactive program for display and analysis of data: User's manual.** Sullivan, J.D.; Grisar, C.C. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Aug 1987. Contract AC02-78ET51013. 65p. (PFC/RR—86-19). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88002292/JAW.

GENLPLOT is an interactive program written in FORTRAN and running under VAX/VMS that enables technicians, scientists, engineers, and other users to quickly and accurately examine and analyze data. The current version utilizes the GRAPAC4 plot package, reads a standard input file or permits direct data entry, and is optimized for use with data stored in MDS databases. This program has been the principal interactive data analysis tool used on the Tara Tandem Mirror Experiment and on the Constance II Mirror Experiment. The program is menu driven with options selected on command lines distinguished by various prompts. Subsequent changes and additions to the program will be indicated by a version number greater than that appearing in the welcome message and will be documented in the appropriate menu(s).

8313 (GA-A—18763, pp 25, Paper 4) **CIT radiation levels and TFTR observations.** Young, K.M. (Princeton Univ., NJ). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

The major diagnostic system components for plasma R & D are windows, fiber optics, vacuum components, and detectors. Radiation levels at various places throughout a representative tokamak for deuterium-tritium (D-T) operation is presented. This information is compared with results obtained by modeling. Computer codes being developed for diagnostics on the Compact Ignition Tokamak (CIT) are discussed.

8314 (GA-A—18763, pp 23, Paper 7) **Windows.** Iden, D.J. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Windows are of concern for plasma diagnostic systems because they must be transparent to the wavelengths of interest and maintain the structural integrity of the fusion vessel. Radiation damage can severely impair both optical and mechanical properties. The anti-reflective coating chosen for the windows must be able to tolerate a high level of radiation damage before failing. Designs must consider material strength and mounting materials. An adequate materials data base with information on the effects of radiation on mechanical and optical properties is needed.

8315 (GA-A—18763, pp 19, Paper 8) **Organic insulators, inorganic insulators, and rf windows.** Clinard, F. (Los Alamos National Lab., CA). Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

General information is presented on the properties and usefulness of organic insulators, inorganic insulators, and rf windows as applied to plasma diagnostic systems. The organic insulators have difficulties cause by susceptibility to radiation damage, most especially damage to polymers; radiation induced conductivity is also a problem. Among the inorganic insulators, ceramics are usually very resistant to radiation induced damage, but they do show radiation induced conductivity. Not a great deal is known about rf windows. Reduction in transmissivity is a major problem about which there is little basic understanding.

8316 (GA-A—18763, pp 20, Paper 9) **Activation issues.** Cheng, E.T. Feb 1987. NTIS, PC A14/MF A01. Order Number DE87007693/JAW. (CONF-870169—).

From Radiation sensitive materials for CIT diagnostic systems; San Diego, CA, USA (21 Jan 1987).

Activation of materials is a major problem. The primary activity results from fusion neutron activation. The amount of activity depends upon the materials being irradiated, the neutron energy spectra, and the reaction type, the neutron flux level, wall loading, and operating time. The activity presents difficulties for maintenance, public safety, and radioactive waste management.

8317 (INIS-BR—897, pp 50) **Parameter studies on the impact of plasma physics relationships on the data of possible next step ignited tokamak reactors.** Knobloch, A.F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8318 (INIS-BR—897, pp 59) **Neutronic analysis of alternative structural materials for the Intor blanket.** Santos, R. dos. (Centro de Informacoes Nucleares, Rio de Janeiro, Brazil). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8319 (INIS-BR—897, pp 28) **FRC formation studies in a field reversed theta pinch with a variable length coil.** Magueda, R.; Sobehart, J.; Rodrigo, A.B. (Comision Nacional de Energia Atomica, Quito, Equador). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8320 (INIS-BR—897, pp 100) **Main features of the extrap device.** Tendler, M. (Royal Institute of Technology, Stockholm, Sweden. Plasma Physics and Fusion Research). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8321 (INIS-BR—897, pp 105) **Field configuration produced by a linear theta-pinch, TUPA-I.** Kayama, M.E.; Boeckelmann, H.K.; Sakanaka, P.H.; Machida, M. (Universidade Estadual de Campinas, Brazil. Inst. de Fisica). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8322 (INIS-BR—897, pp 109) **Compact Tokamak Configurations driven by rotating magnetic fields.** Durance, G.; Bertram, W.K.; Collins, G.A.; Donnelly, I.J.; Hogg, G.R.; Rose, E.K.; Trendys, J.; Watterson, P.A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8323 (INIS-BR—897, pp 113) **ROS: project of a relevant facility in nuclear fusion research.** Pouzo, J. (Consejo Nacional de Investigaciones Cientificas e Tecnicas, Buenos Aires, Argentina). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8324 (INIS-BR—897, pp 49) **Comparison between CNEA $\theta$-pinch experimental data and rotating snow-plow model.** Fuentes, N.O. (Comision Nacional de Energia Atomica, Buenos Aires, Argentina. Div. de Fusion Nuclear). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8325 (INIS-BR—897, pp 23) **Advances in laser fusion.** Yamanaka, C. (Yamagata Univ., Japan. Faculty of Science). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8326 (INIS-BR—897, pp 38) **Reactor potential of the magnetically insulated inertial fusion (MICF) system.** Kammash, T. (Michigan Univ., Ann Arbor, USA). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8327 (INIS-BR—897, pp 41) **High power lasers and experiments.** Holzrichter, J.F. (Lawrence Livermore National Lab., CA, USA). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8328 (INIS-BR—897, pp 70) **Preliminary assessment of the prospects of nuclear fusion and fission as viable power.** Molin, A.; Heindler, M.; Kernbichler, W. (Technische Univ., Graz, Austria. Inst. fuer Theoretiche Physik). 1987. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700657/JAW. (CONF-870836—).

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

8329 (JAERI-M—87-105) **Computer system for the beam line data processing at JT-60 prototype neutral beam injector.** Horiike, Hiroshi; Kawai, Mikito; Ohara, Yoshihiro. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751437/JAW.

The present report describes the hard and soft wares of the data acquisition computer system for the prototype neutral injector unit for JT-60. In order to operate the unit, more than hundreds of signals of the beam line components have to be measured. These are mainly differential thermometers for the coolant waters and thermocouples for the beam dump components but not include those for the cryo system. Since the unit operates in a series of pulses, the measurement should be conducted very quickly in order to ensure the simultaneity of large number of the measured data. The present system actualize fast data acquisition using a small computer of 128 kB and measuring instruments connected through the bus. The system is connected to the JAERI computer center since the data capacity is fairly large to completely process them by the small computer. Therefore the measured data can be transferred to the computer center to calculate there, and the results can be received. After the system was completed the computer quickly print out the power flow data, which needed much work to calculate with hands. This system was very useful. It enhanced the experiments at the unit and reduced the labor. It enables us to early demonstrate the rated operation of the unit and to accurately estimate such operation data of the JT-60 NBI as the injection power.

8330 (JAERI-M—87-109) **Consistency between current ramp-up/recharging scenario by non-inductive current drive and dense and cold divertor plasma. Conceptual design study of FY86 FER.** Hitoki, Shigehisa; Sugihara, Masayoshi; Yamamoto, Shin and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 39p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751438/JAW.

Consistency between non-inductive current drive and the formation of cold and dense divertor plasma in phases of plasma current ramp-up and recharging. When we consider the current drive efficiency obtained in the experiments of JT-60 as the actual upper limit, it is difficult to realize the low plasma temperature below 50 eV near the divertor plate for the reasonable absorbed power (20MW) in FER. Divertor plasma temperature is reduced to about 20 eV for the absorbed power 30 MW. It is essentially important to increase the drive efficiency in order to attain the cold divertor plasma. When we use the slightly higher efficiency model than the experimental result of JT-60, the divertor plasma temperature will be reduced to 20 eV and about 10 eV for the absorbed power 20 MW and 30 MW respectively.

8331 (JAERI-M—87-117) **Magnetic fluctuations in L-mode and H-mode on the JFT-2M tokamak.** Mori, Masahiro; Miura, Yukitoshi; Suzuki, Norio and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki, Japan. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751442/JAW.

Magnetic fluctuations ($2.5\ \text{kHz} < f < 50\ \text{kHz}$) have been investigated by pick-up coils in a H-mode divertor discharge and a H-mode-like limiter discharge of the JFT-2M tokamak. A clear correlation between an L-to-H transition and a reduction of the fluctuation is obtained in both cases. The high frequency fluctuation ($f > 10\ \text{kHz}$) enhanced by beam heating has been observed in the L-mode of a fully expanded limiter discharge.

8332 (JAERI-M—87-118) **Development of TPERM code to calculate tritium diffusion in fusion reactor structures.** Nakahara, Katsuhiko; Seki, Yasushi. (Toshiba Corp., Kawasaki, Kanagawa, Japan). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 57p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751443/JAW.

This report describes the development of TPERM code, which can analyze tritium diffusion in the fusion reactor's structures such as the first wall and the divertor. The phenomena of diffusion including Fick's law, Soret effect, trapping and detrapping in the defects of structural materials, recombination at the surface, and natural decay are modeled in the TPERM code. In addition, temperature calculation can be executed with diffusion calculation, so temperature feedback to the material constants can be obtained in the time dependent analysis. This report includes the description of TPERM's physical models and calculation, the comparison of calculated results with those of the other existing codes, and the estimation of the following quantities for the Fusion Experimental Reactor (FER), tritium inventory, permeation rate to coolant and release rate at baking.

8333 **(JAERI-M—87-127) ICRF-enhancement of beam-induced tail temperature.** Yamagiwa, Mitsuru; Takizuka, Tomonori; Kimura, Haruyuki; Azumi, Masafumi. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751448/JAW.

Enhancement of temperature of the beam-induced ion tail due to second harmonic ICRF (ion cyclotron range of frequency) waves is investigated. The ion distribution function is calculated analytically by use of a Fokker-Planck equation combined with the beam source and quasi-linear RF (radio-frequency) diffusion terms. A simple scaling of the "extendedtail temperature" with respect to the deposited RF power density is presented. Comparison is made with numerical results by using a two-dimensional Fokker-Planck code. It is found that the numerical results for beam injection nearly-perpendicular to the magnetic field are in good agreement with the analytical ones. Also discussed is comparison with the experimental data.

8334 **(JAERI-M—87-129) Data acquisition system in JFT-2M tokamak.** Matsuda, Toshiaki; Matoba, Tohru; Mori, Masahiro; Kawakami, Tomohide; Kashiwa, Yoshitoshi; Yokoyama, Kenji; Matsuzaki, Yoshimi; Takada, Susumu. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 48p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751449/JAW.

Data acquisition system for JFT-2M tokamak has been developed. It handles systematically many types of data; monitoring data of JFT-2M machine, power supplies, plasma control system, several heating apparatus and a variety of data measured with diagnostic instruments. The system consists of a main super mini-computer, a front-end mini-computer and two CAMAC serial highways. Its main characteristics are good man-machine interface and the flexibility to the extended use. These are realized by table generators for a setup of control parameter of CAMAC module, serial highway, etc. and table handlers. In the tokamak experiment, the system can processes about 1.5 Mbyte data during the discharge interval of 3.5 minutes.

8335 **(JAERI-M—87-137) Main engineering features driving design concept and engineering design constraints. Conceptual design study of FY86 FER.** Saito, Ryusei; Kobayashi, Takeshi; Yamada, Masao and others. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 75p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751453/JAW.

Major engineering design philosophies are described, which are essential bases for an engineering design and may have significant impacts on a reactor design concept. Those design philosophies are classified into two groups, engineering design drivers and engineering design constraints. The design drivers are featured by the fact that a designer is free to choose and the choice may be guided by his opinion, such as coil system, a mechanical configuration, a tritium breeding scenario, etc.. The design constraints may follow a natural law or engineering limit, such as material strength, coil current density, and so on.

8336 **(JAERI-M—87-143) Fabrication and performance tests of a prototype in-situ coating machine for JT-60.** Obara, Kenjiro; Abe, Tetsuya; Murakami, Yoshio. (Japan Atomic Energy Research Inst., Naka, Ibaraki. Naka Fusion Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 70p. (In Japanese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751455/JAW.

Prior to the design and construction of the JT-60's in-situ coating device, a prototype machine was fabricated and tested to confirm the applicability of proposed driving methods and mechanical elements to the device which would be operated in very severe conditions including high ambient temperature and high vacuum. The machine basically consists of an in-vessel manipulator, a fiberscope and an ohmically heated titanium evaporator. From the test results, we recommended to use the combination of Inconel 625 and a self-lubricating alloy for the solid-lubricated bearings and MoS/sub 2/-coated Inconel 625 for the solid-lubricated gears. It was also found that TiC coating showed a effect for the prevention of welding between bolts and nuts. In order to optimize the operating parameters of the machine, many wall inspection tests and titanium evaporation tests were carried out in a large vacuum vessel by simulating the JT-60 conditions.

8337 **(PPPL—2480) Role of CIT [Compact Ignition Tokamak] in the US Fusion Program.** Furth, H.P. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1987. Contract AC02-76CH03073. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003454/JAW.

The Compact Ignition Tokamak is designed to obtain extensive scientific and technological data in support of burning-plasma operation in the Engineering Test Reactor and beyond. 8 figs., 3 tabs.

8338 **(PPPL—2483) Self-consistent, three-dimensional equilibrium effects on tokamak magnetic field ripple.** Johnson, J.L.; Reiman, A.H. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Oct 1987. Contract AC02-76CH03073. 20p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003457/JAW.

Self-consistent equilibrium effects on tokamak magnetic field ripple have been calculated using a three-dimensional equilibrium code. The effects are found to be large enough that they should be included in tokamak ignition experiment designs. Even the modification of the well depth associated with the flow of force-free plasma current along rippled field lines is substantial. An analysis of the results separates the contribution of the Shafranov shift to the ripple modification from the contributions of other finite-pressure effects. 5 refs., 10 figs., 1 tab.

8339 **(UCRL—15911) Fusion reactor cost reductions by employing non-nuclear grade components.** Bourque, R.F.; Maya, I.; Schultz, K.R.; Sonn, D.L.; Wise, R.K. (GA Technologies, Inc., San Diego, CA (USA); California State Univ., Long Beach (USA)). Sep 1987. Contract W-7405-ENG-48. 7p. (CONF-871007—55). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002455/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Cascade inertial confinement fusion reactor fits the requirements of low radioactive inventories and inherent safety and is therefore a candidate for non-nuclear construction throughout. This reactor consists of a rotating blanket of ceramic granules that absorb the energy from D-T target explosions occurring along the rotational axis. Laser energy is beamed in axially from both ends. Two cost estimates were made for an 815 MWe Cascade power plant. One was based on an "all conventional" plant, which is constructed and costed using well-established, conventional fossil power plant methods. The second was a "nuclear plus conventional" design, constructed and costed using a combination of fossil and fission reactor plant methods and standards that would be typical of advanced fission reactors. The total capital requirements for the "all conventional" construction plant were estimated in 1985 dollars at $1490 M, including indirect costs. Similarly, the "nuclear plus conventional" construction plant was estimated at $1940 M. The savings of $450 M (23%) represents strictly the difference between Cascade ICF power plants designed and constructed to nuclear safety-related requirements versus all non-nuclear. This example clearly shows that, if fusion plants can take advantage of low activation materials and inherent safety features to eliminate the need for nuclear-related expenses, then such plants may have economic advantages over nuclear-grade systems. 13 refs., 1 fig., 5 tabs.

8340 **(UCRL—15925) Initial operation of a high-power whispering-gallery-mode gyrotron.** Felch, K.; Ives, L.; Jongewaard, E.; Jory, H.; Spang, S. (Varian Associates, Inc., Palo Alto, CA (USA)). Oct 1987. Contract W-7405-ENG-48. 4p. NTIS, PC A02. Order Number DE88002500/JAW.

Varian has begun the development of a high-power gyrotron based on a whispering-gallery-mode interaction circuit. The first experimental tube has been designed to generate pulsed output powers up to 1 MW at a frequency of 140 GHz. The tube was also designed for CW operation at power levels of several hundred kilowatts. The overall design of the tube is discussed. Fabrication of the tube is nearing completion and initial tests on the tube will be carried out in the near future. 5 refs., 2 figs.

8341 **(UCRL—53766-Summ.) Summary of the report of the Senior Committee on Environmental, Safety, and Economic Aspects of Magnetic Fusion Energy.** Holdren, J.P.; Berwald, D.H.; Budnitz, R.J.; Crocker, J.G.; Delene, J.G.; Endicott, R.D.; Kazimi, M.S.; Krakowski, R.A.; Logan, B.G.; Schultz, K.R. (Lawrence Livermore National Lab., CA (USA)). 10 Sep 1987. Contract W-7405-ENG-48. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003270/JAW.

The Senior Committee on Environmental, Safety, and Economic Aspects of Magnetic Fusion Energy (ESECOM) has assessed magnetic fusion energy's prospects for providing energy with economic, environmental, and safety characteristics that would be attractive compared with other energy sources (mainly fission) available in the year 2015 and beyond. ESECOM gives particular attention to the interaction of environmental, safety, and economic characteristics of a variety of magnetic fusion reactors, and compares them with a variety of fission cases. Eight fusion cases, two fusion-fission hybrid cases, and four fission cases are examined, using consistent economic and safety models. These models permit exploration of the environmental, safety, and economic potential of fusion concepts using a wide range of possible materials choices, power densities, power conversion schemes, and fuel cycles. The ESECOM analysis indicates that magnetic fusion energy systems have the potential to achieve costs-of-electricity comparable to those of present and future fission systems, coupled with significant safety and environmental advantages. 75 refs., 2 figs., 24 tabs.

8342 **(UCRL—96442) Magnet technology for the Engineering Test Reactor.** Henning, C.D.; Miller, J.R. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1987. Contract W-7405-ENG-48. 5p. (CONF-870901—11). NTIS, PC A02. Order Number DE88002578/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The consideration for building an international Engineering Test Reactor emerged from the November 1985 Geneva Summit, in which President Reagan and Secretary Gorbachev called for the "widest practical development of international cooperation" in fusion. In parallel with the OTR design in the USSR, the FER in Japan, and the NET in Europe, the US has pursued the TIBER (Tokamak Ignition/Burn Experimental Reactor). This compact design of 3-m major radius is achievable because of high-current-density, radiation-tolerant magnets with nuclear heating rates up to 10 mW . $cm^{-3}$. Full development of cable-in-conduit conductors (CICC) is seen as a credible path to achieve 40 A . $mm^{-2}$ at fields of 12 T in the toroidal field (TF) coils and 14 T in the central poloidal field (PF) coils. Since neutron fluences of up to $10^{19}$ n . $cm^{-2}$ are expected in the TF coils, the unalloyed niobium-tin would be superior at 12 T. However, the central PF coil at 14 T is better shielded, so modified niobium tin would be advantageous. Polyimide insulation in the TF coils would withstand the equivalent $10^{10}$) rads if loads in the winding pack are taken in compression. 13 refs., 7 figs., 2 tabs.

8343 **(UCRL—96599) The LLNL HFTF [High-Field Test Facility]: A flexible superconducting test facility for fusion magnet development.** Miller, J.R.; Chaplin, M.R.; Leber, R.L.; Rosdahl, A.R. (Lawrence Livermore National Lab., CA (USA)). 17 Sep 1987. Contract W-7405-ENG-48. 5p. (CONF-870901—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002384/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The High-Field Test Facility (HFTF) is a flexible and, in many ways, unique facility at Lawrence Livermore National Laboratory (LLNL) for providing the test capabilities needed to develop the superconducting magnet systems of the next generation fusion machines. The superconducting coil set in HFTF has been operated successfully at LLNL, but in its original configuration, its utility as a test facility was somewhat restricted and cryogenic losses were intolerable. A new cryostat for the coil set allows the magnet system to remain cold indefinitely so the system is available on short notice to provide high fields (about 11 T) inside a reasonably large test volume (0.3-m diam). The test volume is physically and thermally isolated from the coil volume, allowing test articles to be inserted and removed without disturbing the coil cryogenic volume, which is maintained by an on-line refrigerator. Indeed, with the proper precautions, it is even unnecessary to drop the field in the HFTF during such an operation. The separate test volume also allows reduced temperature operation without the expense and complication of subcooling the entire coil set (about 20-t cold mass). The HFTF has thus become a key facility in the LLNL magnet development program, where the primary goal is to demonstrate the technology for producing fields to 15 T with winding-pack current densities of 40 $A.mm^{-2}$ in coils sized for fusion applications. 4 refs., 4 figs., 1 tab.

8344 **(UCRL—96863) Cryogenic magnet case and distributed structural materials for high-field superconducting magnets.** Summers, L.T.; Miller, J.R.; Kerns, J.A.; Myall, J.O. (Lawrence Livermore National Lab., CA (USA)). 9 Oct 1987. Contract W-7405-ENG-48. 6p. (CONF-871007—58). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002393/JAW.

From Symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The superconducting magnets of the Tokamak Ignition/Burn Experimental Reactor (TIBER II) will generate high magnetic fields over large bores. The resulting electromagnetic forces require the use of large volumes of distributed steel and thick magnet case for structural support. Here we review the design allowables, calculated loads and forces, and structural materials selection for TIBER II. 7 refs., 2 figs., 3 tabs.

8345 **Unified first wall-blanket structure for plasma device applications.** Gruen, D.M. (to Dept. of Energy, Washington, DC). US Patent 4,698,198. 6 Oct 1987. Filed date 4 Feb 1986. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

This patent describes a nuclear reaction plasma device for generating neutron streams having a plasma and a structure serving as both the first wall and the blanket. The structure comprises: a first wall for containment of plasma at elevated temperatures. The first wall adjoins and exposes an inner plasma zone thereby providing a first barrier to the plasma and a blanket containing multiple channels for channeling helium and multiple passages for channeling water through the blanket. The blanket is for generation of sensible heat from the neutron streams. The first wall comprises an inner surface for exposure to the plasma. The inner surface and the blanket are of a one-piece structure initially composed of a metallic solid solution containing a major amount of copper and about 15-25 at.% of lithium and melting above about 500°C. The blanket includes means for adding lithium vapor to the helium gas being channeled to the blanket for replacing lithium converted to tritium. The walls of the channels are composed of a material which will allow transfer of tritium from the blanket into the helium gas passing through the channels and transfer of the lithium vapor from the helium gas into the blanket.

8346 **Design and fabrication of the multipinch experimental device.** Curwen, B.; Graumann, D.W.; La Haye, R.J. (GA Technologies, Inc., P.O. Box 85608, San Diego, CA 92138). *Fusion Technology;* **12**: No. 2, 257-269(Sep 1987).

The multipinch experimental device was constructed to study the stability and plasma confinement properties of a reversed-field pinch (RFP) with a magnetic well. The magnetic well is created by shaping an RFP configuration into two equal-current lobes in which the poloidal field cancels at the X point of a figure-eight-shaped magnetic separatrix. The design and construction of a 0.525-m major radium modular machine to study this unique plasma configuration is described. A novel construction technique for the non-circular cross-section plasma chamber, incorporating a thin metal

skin, phenolic honeycomb, and graphite/epoxy composite bonded sandwich structure, is discussed. Details of the fabrication of the vacuum liner, conducting shell, the toroidal and poloidal coil systems, and the iron core are given.

8347 **Three-cell, large-mirror-ratio tandem mirror magnetic design studies.** Francis, G.L.; Myra, J.R.; D'Ippolito, D.A.; Catto, P.J.; Aamodt, R.E. (Science Applications International Corp., Plasma Research Institute, 1515 Walnut Street, Boulder, CO 80302). *Fusion Technology;* 12: No. 2, 230-237(Sep 1987).

A systematic study of magnetic designs has been carried out for three-cell choke coil quadrupole-stabilized tandem mirror reactors, comparable in size to the (octopole) MINIMARS design. In these designs, a single-mirror cell at each end of the machine serves as an end plug, thermal barrier, and magnetohydrodynamic anchor. The multiple functions of the end plugs make it difficult to simultaneously optimize the physics properties of the plasma (stability, radial confinement, and good particle drift orbits). Two different design approaches have been studied using recently developed magnetic optimization techniques. Typical physics figures of merit are given and critical issues discussed for each design. When the various constraints associated with the high-field choke coil are taken into account, it is found that an acceptable design is beyond the reach of present technology.

8348 **TIBER II configuration and structural design.** Doggett, J.N. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 5511, L-643, Livermore, CA 94550). pp 1881-1886 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—). Contract W-7405-ENG-48.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The TIBER-II machine is a minimum-size steady-state tokamak with sufficient fusion power, wall flux, and fluence to be used for undertaking a nuclear test mission. Although the machine is envisioned as an engineering device, it demonstrates reactor-relevant physics. To achieve the small size and high performance goals of TIBER II, the engineered systems must be based on aggressive assumptions. In addition, the machine must be designed for ease of maintenance to ensure reaching the fluence goal of 5 MW yr/m/ sup 2/ in a design lifetime of 13 years. This paper concentrates on the configuration and structural issues of designing a small, high-field, and high-flux device.

8349 **Plant design for reversed field pinch reactor (titan).** Dabiri, A.E. (Fusion Engineering Design Center, Science Applications International Corp., P.O. Box Y, FEDC Building, Oak Ridge, TN 37831). pp 1851-1856 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Various energy conversion systems have been reviewed in order to select an efficient power cycle compatible with the Reversed Field Pinch (RFP) reactor requirements. The power cycles were selected for two reactor designs, liquid lithium-cooled and aqueous water-cooled first wall/blanket. The steam cycle was found to be most suitable for the RFP reactor. The result of a preliminary plant availability study indicates that a compact RFP reactor may have a potential for higher availability over the conventional Tokamak fusion reactor.

8350 **Excimer laser development for fusion.** Giovanielli, D. (Los Alamos National Lab., NM, USA). *Laser and Particle Beams;* 4: No. 3-4, 569-571(Aug-Nov 1986). (CONF-851128—).

From 17. European conference on laser interaction with matter; Rome, Italy (18 Nov 1985).

The future utility of inertial confinement fusion requires a new driver. Successful experiments coupling laser energy to targets, and our understanding of fuel capsule behavior strongly suggest that a Laboratory thermonuclear source is attainable and power production may be considered if a suitable driver with high efficiency, high repetition rate, and most importantly, low capital cost, can be identified. No adequate driver exists today; however, the krypton fluoride laser holds great promise. By the end of this decade, driver development can be brought to the point that a technically justifiable choice can be made for the future direction of ICF.

8351 **Reconnection in Spheromak formation and sustainment.** Hammer, J.H. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). pp 319-331 of Magnetic reconnection in space and laboratory plasma. Hones, E.W. Washington, DC; American Geophysical Union (1984). (CONF-8310229—).

From Chapman conference on magnetic reconnection; Los Alamos, NM, USA (3 Oct 1983).

Reconnection phenomena observed in Spheromak magnetic confinement experiments are reviewed. Many features of the observations are consistent with a model based on three-dimensional magnetic relaxation while preserving global magnetic helicity.

8352 **The role of magnetic reconnection phenomena in the reversed-field pinch.** Baker, D.A. (Los Alamos National Lab., Los Alamos, NM 87545). pp 332-340 of Magnetic reconnection in space and laboratory plasma. Hones, E.W. Washington, DC; American Geophysical Union (1984). (CONF-8310229—).

From Chapman conference on magnetic reconnection; Los Alamos, NM, USA (3 Oct 1983).

The reversed-field pinch (RFP), an axisymmetric toroidal magnetic confinement experiment, has physics rich in the area commonly called field line reconnection or merging. This paper reviews the topics where reconnection plays a vital role: (a) RFP formation and the phenomenon of self-reversal, (b) RFP sustainment in which the RFP configuration has been shown to be capable of maintaining itself for times much longer than earlier predictions from classical resistive MHD theory, (c) steady state current drive in which "dynamo action" and associated reconnection processes give rise to the possibility of sustaining the configuration indefinitely be means of low frequency ac modulation of the toroidal and poloidal magnetic fields, (d) the effects of reconnection on the formation and evolution of the magnetic surfaces which are related to the plasma containment properties. It appears that all phases of the RFP operation are intimately related to the reconnection and field regeneration processes similar to those encountered in space and astrophysics.

# 99 GENERAL AND MISCELLANEOUS

## 9901 Management

8353 **(DOE/IG—0008/10-4) Office of Inspector General: Semiannual report to the Congress, April 1-September 30, 1987.** (USDOE Office of Inspector General, Washington, DC). Nov 1987. 54p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88002812/JAW.

The Office of Inspector General's audit, investigation, and inspection activities are directed toward helping the Department improve its operations and to detect and prevent fraud, waste, and mismanagement. During this reporting period, we issued 196 audit reports. As a result of reviews of cost proposals and contract billings, we determined that $66.4 million in costs were either unallowable or unsupported. Investigations of wrongdoing led to 12 referrals for prosecution, 5 convictions, 3 indictments, and 7 disciplinary actions. Other initiatives by this Office have produced recommendations to improve the Department's operations to recover funds and to more efficiently use funds. These recommendations amounted to about $158 million.

8354 **(DOE/IG—0245) Use of functional analysis to reduce the cost of weapons production facilities.** (USDOE Office of Inspector General, Washington, DC). Nov 1987. 12p. H. Order Number TI88002827/JAW.

Report to the Secretary.

Purpose of the inspection was to identify cost reduction opportunities within the Department's Weapons Production complex.

Our review included visits to the major weapons production facilities within the complex, interviews with program officials and contractor representatives, and examination of relevant files, reports, studies and other documents. Additional information was obtained through interviews with Defense Programs officials at Headquarters and senior program officials at the Albuquerque Operations Office (ALOO), as well as examination of documents obtained from these officials.

8355 **(INIS-mf—10763) Annual report 1986 of Society for Reactor Safety (GRS).** (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). 1987. 89p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751287/JAW.

The overall development of Society for Reactor Safety (GRS) is indicated by its annual volume of achievement. After initially high growth rates that achievement has come to stand at some 62 million marks or so over the last years. GRS today employs some 450 staff, of which 325 are scientific-technical experts representing altogether nearly 4000 man-years of experience in nuclear technology. The report presents essential results from the main points of activity of GRS over 10 years. In accordance with the aim of the institution they primarily cover projects in the sectors safety and radiation protection for nuclear facilities. Since 1985, since the extension of its contract of associates, GRS has also increasingly been concerned with safety questions in non-nuclear technology, concentrating mainly on the transfer of existing methods.

## 9902 Mathematics And Computers

*REFER ALSO TO CITATION(S) 7969*

8356 **(AD-A—184660/9/XAB) Implementation of the Runge-Kutta-Fehlberg method for solution of ordinary differential equations on a parallel processor. Master's thesis.** Mayo, C.F. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1987. 51p. NTIS, PC A04/MF A01.

A recent advance in computer architecture, the parallel-processor computer, has made it theoretically feasible to reduce the time required to integrate a system of n ordinary differential equations by a factor of n. One established numerical technique, the Runge-Kutta-Fehlberg method, is adapted for parallel processing on an Intel Scientific Computer iPSC Concurrent Supercomputer. The algorithm is evaluated using a standardized collection of systems of equations. It is concluded that this type of parallel processor is not suited for the solution of this problem due to the communications overhead required. Short developments of ordinary differential equations and numerical-integration methods are provided as background.

8357 **(AD-A—184745/8/XAB) Nonlinear etalons and optical computing. Report for 1 October 1985-30 September 1986.** Gibbs, H.M.; Peyghambarian, N. (Arizona Univ., Tucson (USA). Optical Sciences Center). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in SPIE, Vol. 634, 142-148(1986).

Nonlinear optics can contribute decisions to optical signal processing and computing. Etalons permit massive parallelism and global interconnectivity. GaAs etalons appear more attractive for real systems, but ZnS interference filters are convenient for simple demonstrations of logic operations and pattern recognition.

8358 **(ANL/TM—457) Using the Hydra Protocol Converter for IBM full screen terminal emulation at ANL.** Hinds, A.R.; Leibfritz, D.W. Lurie, G.R.; Slocum, R.E. (ed.). (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003277/JAW.

The Hydra Protocol Converter is a dedicated microprocessor that allows selected ASCII terminals and personal computers emulating ASCII terminals to use IBM 3277-type terminal full screen capabilities. Connections to Hydra through the Argonne Private Branch Exchange (PBX) provide full-screen terminal access to all the central IBM computer interactive services (CMS, MVS Sylbur, CICS, and MVS TSO). These services are more flexible and easier to use if you have full screen terminal capabilities; the Hydra provides excellent emulation of most IBM 3277 terminal features, and it displays the effects of your keystrokes immediately on your terminal screen. In addition, the Hydra permits you to transfer files between CMS and personal computers running either the Kermit or RELAY Gold programs. The Hydra communicates asynchronously at communication speeds ranging from 300 baud to 19.2 kilobaud (a baud is one bit, or binary digit, per second). Generally, use the fastest speed (baud rate) that your ADI (Asynchronous Data Interface) or modem, and terminal or terminal emulation program can sustain; the Hydra will automatically adjust to the speed you have set. There are several methods of emulating full screen IBM terminals besides using the Hydra (such as software packages). However, the Hydra is the most efficient method at Argonne. Throughout this document, all mention of full screen emulation refers to emulating IBM 3277-type terminals with the Hydra. 1 fig., 9 tabs.

8359 **(DOE/ER/13118—T2) Caltech Concurrent Computation Program: Annual report, 1984-1985.** Fox G. (California Inst. of Tech., Pasadena (USA)). Jul 1985. Contract AS03-83ER13118. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002548/JAW.

This report describes the current status of the Caltech Concurrent Computation Program, which is a major effort at both the Caltech campus and JPL (Jet Propulsion Laboratory). The major goal of the program is to develop the capability of concurrent processors for general purpose computation with special emphasis on science and engineering. We are developing computers whose (hypercube) architectures "scale" to a large number of nodes and consequently, to much greater computational power than any sequential machines. In this paper, we describe the status of research in the areas of hardware, systems software, applications software and architectural lessons. 2 figs., 3 tabs.

8360 **(DOE/ER/25007—T1) Conic algorithms for unconstrained minimization with special consideration of problems with large sparse hessians: A summary of research performed.** Ariyawansa, K.A. (Washington State Univ., Pullman (USA). Dept. of Pure and Applied Mathematics). 31 Oct 1987. Contract FG06-85ER25007. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88002549/JAW.

This paper contains a brief description of research activities on conic algorithms for unconstrained minimization. Line search termination criteria and the rate of convergence for a certain class of conic algorithms are for sparse problems are discussed. (LSP)

8361 **(JAERI-M—87-136) Adaptability of vector-parallel processing to nuclear codes.** Asai, Kiyoshi; Yokokawa, Mitsuo; Chino, Masamichi and others. (Japan Atomic Energy Research Inst., Tokai, Ibaraki, Japan. Tokai Research Establishment). (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 115p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751452/JAW.

In this report the adaptability of a vector-parallel computer architecture to nuclear computations is reviewed. In the first chapter, the necessity of high speed computations in the nuclear fields is presented. In the second chapter, a methodology of vector-parallel processing is proposed as a natural extension of the vector processing. In the third chapter, eight nuclear codes are surveyed from the standpoint of the vector-parallel processing. They are WIND04 for the wind field calculation in three dimensional complex terrains by finite difference method, PRWDA for polutants dispersion and concentration calculation in three dimensional complex terrains by particle-in-cell method, BERMUDA-3DN for neutron transport calculation by direct integration method, KENO-IV for neutron transport calculation in three dimensional complex geometries by Monte Carlo method, CITATION for neutron diffusion calculation by finite difference method, TRAC-PF1 for nuclear reactor accident calculation by finite difference method, AEOLUS-RT for plasma instability calculation in a Tokamak type experimental fusion device by Fourier expansion method, and SPIN for phase transition of ferromagnetic materials by transfer matrix method of Ising models. It

is shown in the report that all codes, except KENO-IV TRAC-PF1, are well suited to the vector-parallel processing, that is, they can gain speedup ratios VP x PP of vector processing ratios VP multiplied by parallel processing ratios PP. Although KENO-IV and TRAC-PF1 can only get low speedup ratios by vectorization in our present applications, our analysis show that it is better to use vector-parallel processing than to use only parallel processing in multi-processors equipped with vector processing facilities environments.

8362 **(LA—11145-MS) T/sub E/X made easy.** Coen, K.H. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002705/JAW.

T/sub E/X is a computer typesetting system developed by Donald E. Knuth, Stanford University. The T/sub E/X system tells a computer exactly how the manuscript, letter, or other document is to look. The material included here is not intended to be a complete T/sub E/X guide; there are several such resources available. Instead, this document is meant to help the new T/sub E/X user become more familiar with some of the basic T/sub E/X commands, produce a letter, memo, or simple paper, and later produce beautiful T/sub E/X creations. T/sub E/X is a very powerful system, and the desired results can be achieved in more than one way.

8363 **(LA-UR—87-3015) The KIVA-II computer program for transient multidimensional chemically reactive flows with sprays.** Amsden, A.A.; Butler, T.D.; O'Rourke, P.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 18p. (CONF-871142—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000502/JAW.

From International fuels and lubricants meeting and exposition; Toronto, Canada (2 Nov 1987).

Since its public release in 1985, the KIVA computer program has been utilized for the time dependent analysis of chemically reacting flows with sprays in two and three space dimensions. This paper describes some of the improvements to the original version that have been made since that time. The new code called KIVA-II is planned for public release in early 1988. KIVA-II improves the earlier version in the accuracy and efficiency of the computational procedure, the accuracy of the physics submodels, and in versatility and ease of use. Numerical improvements include the use of the ICE solution procedure in place of the acoustic subcycling method and the implementation of a quasi-second-order-accurate convection scheme. Major extensions to the physical submodels include the inclusion of an optional k-$\epsilon$ turbulence model, and several additions to the spray model. We illustrate some of the new capabilities by means of example solutions. 25 refs., 7 figs.

8364 **(N—87-30114) Implicit Runge-Kutta methods for parallel computations.** Keeling, S.L. (National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center). Sep 1987. 24p. (NASA-CR—178366; ICASE—87-58; NAS—1.26:178366). NTIS, PC A02/MF A01.

Implicit Runge-Kutta methods which are well-suited for parallel computations are characterized. It is claimed that such methods are first of all, those for which the associated rational approximation to the exponential has distinct poles, and these are called multiply explicit (MIRK) methods. Also, because of the so-called order reduction phenomenon, there is reason to require that these poles be real. Then, it is proved that a necessary condition for a q-stage, real MIRK to be A sub 0-stable with maximal order $q + 1$ is that $q = 1, 2, 3$, or 5. Nevertheless, it is shown that for every positive integer q, there exists a q-stage, real MIRK which is I-stable with order q. Finally, some useful examples of algebraically stable MIRKs are given.

8365 **(PB—87-230454/XAB) Parallel algorithms for unconstrained and constrained nonlinear optimization.** Lootsma, F.A. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1986. 40p. (REPT—86-15). NTIS, PC E03/MF A01.

This survey is concerned with variants of nonlinear-optimization methods designed for implementation on parallel computers. The authors consider a particular type of parallellism (simultaneous function and gradient evaluations), and first the authors concentrate on the main sources of inspiration for unconstrained optimization: conjugate directions, variable-metric methods, homogeneous functions, and multi-dimensional searches. Thereafter, the authors discuss two approaches that have recently been employed to solve constrained problems with separable objective and constraint functions: dual methods and quadratic approximations. Finally, the authors outline the key issues in future computational studies of parallel nonlinear optimization algorithms.

8366 **(SLAC-PUB—4416) An interactive visual interface for Fastbus diagnostics.** Gelphman, D.M.; Gustavson, D.B.; Walz, H.V. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1987. Contract AC03-76SF00515. 3p. (CONF-871006—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002569/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

Complex instruments which are not used regularly, such as diagnostic devices, are often avoided or inefficiently used because of the start-up effort required to figure out how to apply them. To solve this problem, we have developed a visual interface for the SLAC FASTBUS Snoop Module. This interface is based on the Macintosh computer's standard human interface, using menus, dialogs and graphics to quickly bring to mind the range of possibilities and allow easy setup and manipulation of the Snoop module's powerful features. 4 refs., 5 figs.

8367 **(UCRL—15958) Monte Carlo photon transport on vector and parallel supercomputers: Final report.** Martin, W.R.; Nowak, P.F. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Dec 1986. Contract W-7405-ENG-48. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002503/JAW.

The University of Michigan has been investigating the implementation of vectorized and parallelized Monte Carlo algorithms for the analysis of photon transport in an inertially-confined fusion (ICF) plasma. The goal of this work is to develop and test Monte Carlo algorithms for vector/parallel supercomputers such as the Cray X-MP and Cray-2. Previous effort has resulted in the development of a vectorized photon transport code, named VPHOT, and a companion scalar code, named SPHOT, that performs the same analysis and is used for comparative purposes to assess the performance of the vectorized algorithm. A test problem, denoted the ICF test problem, has been created and tested with the VPHOT and SPHOT codes. By comparison with a reference LLNL calculation of the ICF test problem, the VPHOT/SPHOT codes have been verified to predict the correct results. Performance results with VPHOT versus SPHOT and the reference LLNL code have been reported previously and indicate that speedups in the range of 6 to 12 can be achieved with the vectorized algorithm versus the conventional scalar algorithm on the Cray X-MP. This report summarizes the progress made during the last year to continue the investigation of vectorized Monte Carlo (parameter studies, alternative vectorized algorithm, alternative target machines) and to extend the work into the area of parallel processing. 5 refs.

8368 **(K/TR—87/2) Guidelines for logical ergonomics of screen design: Report of the European Community Commission.** (Commission of the European Communities, Brussels (Belgium)). 1987. Contract AC05-84OT21400. Translation source information not available . 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003313/JAW.

The purpose of this paper is to study the logical ergonimics of screen design. This document is addressed to data-processing system development managers within the Commission. The authors hope that these recommendations will provide a practical guide to both form and content of screen design. In particular, this paper emphasizes two points. First, taking into account the Commission's various office systems and computer environments, the VT220 is taken as the basic reference for design recommendations. Applications developers can thus be required to respect the specifications of existing equipment at the expense of certain recommendations, while waiting for the arrival of standardized software production tools. Then, IBM's notice "Architecture Unifiee d'Application"

(AUA) or "System Architecture for Applications" (SAA) may lead to modification of certain elements of this document, such as the designation of function keys. The AUA specifications are not presently available. A future revision of this document is therefore foreseeable. 19 refs., 17 figs.

8369 **A fully parallel algorithm for the symmetric eigenvalue problem.** Dongarra, J.J.; Sorensen, D.C. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439). pp S139-S154 of Proceedings of the 2nd conference on parallel processing for scientific computing. Gear, C.W.; Voigt, R.G. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8511169—).

From 2. Society for Industrial and Applied Mathematics conference on parallel processing for scientific computing; Norfolk, VA, USA (18 Nov 1985).

In this paper the authors present a parallel algorithm for the symmetric algebraic eigenvalue problem. The algorithm is based upon a divide and conquer scheme suggested by Cuppen for computing the eigensystem of a symmetric tridiagonal matrix. They extend this idea to obtain a parallel algorithm that retains a number of active parallel processes that is greater than or equal to the initial number throughout the course of the computation. They give a new deflation technique which together with a robust root finding technique will assure computation of an eigensystem to full accuracy in the residuals and in the orthogonality of eigenvectors. A brief analysis of the numerical properties and sensitivity to round off error is presented to indicate where numerical difficulties may occur. The algorithm is able to exploit parallelism at all levels of the computation and is well suited to a variety of architectures. Computational results are presented for several machines. These results are very encouraging with respect to both accuracy and speedup. A surprising result is that the parallel algorithm, even when run in serial mode, can be significantly faster than the previously best sequential algorithm on large problems, and is effective on moderate size problems when run in serial mode.

8370 **A parallel adaptive numerical scheme for hyperbolic systems of conservation laws.** Lucier, B.J.; Overbeek, R. (Purdue Univ., West Lafayette, IN 47907). pp S203-S219 of Proceedings of the 2nd conference on parallel processing for scientific computing. Gear, C.W.; Voigt, R.G. Philadelphia, PA; Society for Industrial and Applied Mathematics (1987). (CONF-8511169—).

From 2. Society for Industrial and Applied Mathematics conference on parallel processing for scientific computing; Norfolk, VA, USA (18 Nov 1985).

The authors generalize the first author's adaptive numerical scheme for scalar first order conservation laws to systems of equations in one space dimension. The resulting numerical method generates highly nonuniform, time-dependent grids, and hence is difficult to execute efficiently on vector computers such as the Cray or Cyber 205. In contrast, the authors show that this type of algorithm may be executed in parallel on alternate computer architectures. We describe a parallel implementation of the algorithm on the Denelcor HEP, a multiple-instruction, multiple-data (MIMD) shared memory parallel computer. This program dynamically partitions the problem domain so as to achieve effective load balancing among the available processes.

8371 **Data driven architecture.** Sippach, W. (Columbia Univ. Nevis Labs., Irvington, NY 10533). pp 222-231 of Proceedings of the workshop on triggering, data acquisition and computing for high energy, high luminosity, hadron-hadron colliders. Cox, B.; Fenney, R.; Hale, P. Batavia, IL; Fermi National Accelerator Laboratory (1985). (CONF-8511150—).

From Workshop on triggering, data acquisition and computing for high energy/high luminosity hadron-hadron colliders; Batavia, IL, USA (11 Nov 1985).

The concept of "data driven architecture" is presented and compared with instruction driven systems. A processor for BNL E766 is briefly described. An argument is made for using data driven principals for the data acquisition and trigger systems at the SSC. The basic principals and properties of data driven architecture have been presented. The author believes they are sufficiently interesting to serve at least as a guideline for designing a very high bandwidth data acquisition and trigger system, as required at SSC.

## 9903 Information Handling

*REFER ALSO TO CITATION(S) 7427*

8372 **(OEFZS-A—1053) Print preparation of the logical INIS-character set for a digital LNO3 printer.** Mueller, M.; Nevyjel, A. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Hauptabteilung Mathematik und Information). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Sep 1987. 31p. (In German). (MI—93/87). Austrian Research Centre Seibersdorf, A-2444 Seibersdorf, Austria.

The implementation of the revised INIS-character set (describedin INIS-Circular Letter No.131) made it necessary to develop a print preparation program, which transfers most of the new INIS logical characters to characters, which are printable on a local LNO3 laser printer. The program is written in PL/I and runs under VAX/VMS on a VAX 11/750. It reads a normal print file and replaces the encoded logical characters by special control sequences, which generate the corresponding images on the LNO3 printer. The program is used for print preparation of any INIS-data records, both input preparation and output tape utilisation on the local VAX system.

## 9905 Civilian Defense

8373 **(AD-A—184667/4/XAB) Mathematical models for the S.D.I. (Strategic Defense Initiative). Master's thesis.** Ilan-Lipowsky, Y. (Naval Postgraduate School, Monterey, CA (USA)). Jun 1987. 154p. NTIS, PC A08/MF A01.

Original contains color plates. All DTIC and NTIS reproductions will be in black and white.

SDI technologies may affect the concepts of weapons systems and reshape the battlefields of the future. In this research, few of the SDI systems were analyzed and modeled mathematically. The different models were gathered in a software package that may be run on a personal computer. The intention was to produce a handy tool for preliminary studies and designs. The following topics are covered: aerodynamic design of hypervelocity projectiles, flight simulation of hypervelocity projectiles, railgun simulation, ground track of orbits, guidance and homing. A few case studies were analyzed to suggest and demonstrate potential use of these models.